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# Dental Management of Cardiovascular Compromised Patient

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## ABSTRACT

Cardiovascular diseases (CVD) comprise of a group of diseases of the heart and vascular system affecting majority of individuals worldwide. Relation between oral health and cardiac diseases has been well established. Common cardiac disorders encountered in a dental practice include arterial hypertension, heart failure, ischemic heart disease, cardiac arrhythmias, infective endocarditis, stroke, and cardiac pacemaker. Patients with CVDs pose a significant challenge to dental therapy. These patients need special considerations and an adequate understanding of the underlying cardiovascular condition to provide safe and effective dental treatment.The present study consists of a literature review dental management of patients suffering from various cardiovascular diseases.

***Keywords:*** *Dentistry, Cardiovascular disease, vasoconstrictor.Dental management*

## 1. INTRODUCTION

Oral health is often viewed in isolation, yet its impact extends far beyond the mouth. Oral health can hurt the heart.Emerging research has established a concerning link between oral health and heart issues. Gum disease, for example, can trigger cardiovascular problems and increase the risk of having a heart attack. Tooth decay and other oral infections in childhood can contribute to atherosclerosis (clogged arteries) in adulthood.[1]

These risks can especially hurt older adults. A majority of seniors have a chronic illness, such as heart disease, which can worsen with poor oral health. However, millions of older adults can't get needed dental care because Medicare doesn't include oral health coverage. [1] Figure 1

Health industry leaders and policymakers can reduce the harms of dental and heart disease in many ways. How? First, let's explore why oral health and hearth disease are connected. [2]

Examination of the patient with a history of medical problems should be more extensive than that associated with the healthy patient. Physical assessment should include evaluation of the patient's general appearance (eg, weight, posture, skin, nails, eyes, lips), blood pressure and temperature, pulse rate, respiratory rate, a thorough head and neck inspection (including assessment of lymph nodes, salivary glands, otologic assessment, assessment of breath smell), and cranial nerve examination. [1-5]

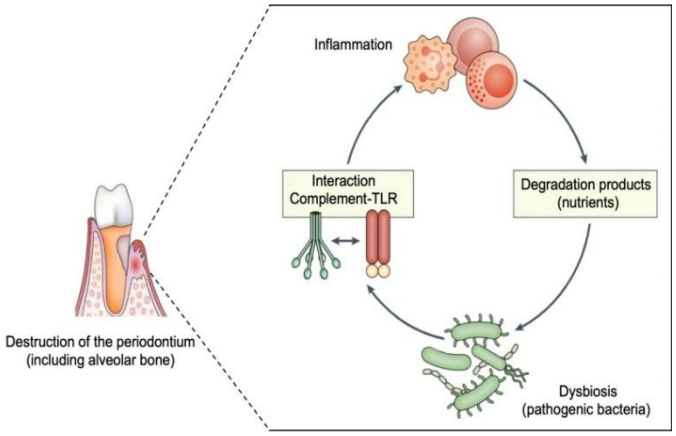


**Figure 1. Amplification of the inflammatory response is responsible for the development of periodontitis**

In patients that present with problems identified at examination that have not previously been reported to a health care practitioner the dentist can be instrumental in defining potential pathology and making the appropriate referral foradditional medical evaluation. Such patients should be referred for medical assessment prior to dental treatment. Assessment of The Medically Compromised Patient (MCP) -Guidelines: **[1-7]** Figure 1

1. Complete Health History;

a) Date of Last Physical Examination;

b)Name, Address and Tel of Specialists;

c) List of Medical conditions being treated;

d) List of medications;

e) Allergies and Medical emergencies experienced;

f) Hospitalizations.

2. Assessment and Management Tools: Lab. Tests: complete blood count (CBC)with Plat. Count and white blood cells (WBC diff). Prothrombin time (PT)/ international normalized ratio(INR); partial thromboplastin time(PTT); BT. Liver function tests(LFTs) and Hepatic Serology Serum Creatinine. Fasting blood sugar test(FBS); postprandial glucose test PP and glycated haemoglobin (HbA1C); CD4 count and Viral Load. **[1]**

Thorough knowledge of Diseases and Medications. Thorough knowledge of Anesthetics, Analgesics, Antibiotics.Screening medically compromised patients goal:To evaluate any source of infection that may compromise successful medical or surgical therapy and restore optimal oral health and function. **[1-10]**

1. Full mouth intra-oral radiographs plus panoramic radiograph

2. Panoramic radiograph only if edentulous or not able to take intraoral films;

3. Thorough medical and dental history, including medications documented on our own dental chart; **[1-12]**

4. Complete dental charting, periodontal charting if appropriate, but periodontal probing of all teeth will routinely be accomplished; **[1-10]**

5. Physician consultation to corroborate medical history and coordinate dental and medical care;

6. Arrange treatment;

7. Arrange followup. Figure 2

| Procedure | Prophylaxis Indicated | Antimicrobial(s) of choice | Alternatives Penicillin allergy[2] | Duration |
|---|---|---|---|---|
| **Oesophagoscopy, Thoracoscopy, Bronchoscopy** | NO | | | |
| **Oesophagoscopy, Bronchoscopy, Mediastinoscopy with procedure e.g biopsy, dilatation** | NO | | | |
| **Thoracoscopy with Pleural procedures or Lung biopsy** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Thoracotomy/ Thoracoscopy with Pulmonary Resection** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Thoracotomy with Insertion of Implant** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Sternotomy** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Thoracotomy for Oesophageal or Gastric surgery** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Laparotomy for Oesophageal or Gastric surgery** | YES | Co-Amoxiclav 1.2g IV[1]<br>*If prolonged >3 hours add three doses of Flucloxacillin 2gm* | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single unless >3 hours (see below) |
| **Patients with MRSA colonisation or high risk of MRSA[3]** | YES | Co-Amoxiclav 1.2 IV[1] PLUS Teicoplanin 10mg/kg | Teicoplanin 10mg/kg PLUS Gentamicin 2mg/kg | Single |

**Figure 2; Antibiotic prophylaxis for (Non Cardiac) Thoracic Surgery**

**2. Antibiotic premedication indications -Initiate preventive therapy (**Protocols for dental management of the medically compromised patient.

1. Prosthetic heart valves; **[1]**

2. Heart murmurs, e.g. MVP (with incompetence) and history of rheumatic fever(RF), rheumatic heart disease(RHD);

3. Patients with congenital heart disease;

4. Dialysis patients -those with A-V shunts and those on CAPD -Continuous ambulatory peritoneal dialysis;

5. Organ transplant patients, pre-and post transplant -depends on "counts";

6. Chemotherapy patients, including bone marrow transplant -depends on "counts";

7. Artificial joint patients;

8. Poorly controlled diabetic patients;

9. Radiation therapy patients, depending on procedure;

10. Bisphosphonatetherapy patients; **[ 1]**

11. Down syndrome patients (many have cardiac defects); **[1]**

12. Immunosuppressed patients (depending on treatment). **[24]**

Main signs and symptoms of cardiovascular diseases: Chest pain; Dyspnea; Cyanosis; Palpitation; Syncope; Edema of ankles; Cold pale extremities; Clubbing fingers; Easy fatigue. **[1-22]**

**3. Dental management of the patients with cardiovascular diseases;**

*a. Angina pectoris;*

*b. Acute myocardial infarction (AMI);*

*c. Arrhythmias;*

*d. Heart failure (HF);*

*e. Arterial hypertension (AHT);*

*f. Prevention of Bacterial Endocarditis;*

*g. Prophylaxis against total joint replacement infection*

**The present study consists of a literature review dental management of patients suffering from various cardiovascular diseases.**

## 2. TREATMENT OBJECTIVE

1. Important goal of treatment to manage patients with cardiovascular diseases is to deal with all the identified risk factors involved. **[1,23]**

2. Pre-medication should be considered to alleviate anxiety and effective analgesia is important to reduce stress. **[1,23-35]**

3. Early and short morning appointments are advised for all such patients.

4. All the patients are allowed to attain a comfortable position in a dental chair.

5. Every effort should be made to keep procedure time down to a minimum, and treatment should be terminated early if the patient becomes overly anxious. **[1,23-35]**

6. Current medications which the patients are taking and allergies to any drugs and also any potential drug interactions and side effects are noted. Figure 3

| Prophylaxis | Adults | Children† |
|---|---|---|
| Standard | Amoxicillin 2 g VO o IV | Amoxicillin 50 mg/kg VO. (Maximum 2 g) |
| Allergic to betalactames | Clindamycin 600 mg VO | Clindamycina 20 mg/kg VO. (Maximum 600 mg) |
| | Azithromycin500 mg VO | Azithromycin 15 mg/kg VO |
| | Claritromicina 500 mg VO | Clarithromycin 15 mg/kg VO |
| Oral intolerance | Ampicillin 2 g mg IM o IV | Ampicillin 50 mg/kg IM o IV |
| Oral intolerance and penicillin allergy | Cefazolin 1 g IM o IV* | Cefazolin 25 mg/kg IM o IV (Maximum 1 g)* |
| | Clindamycin 600 mg IV | Clindamycin 15 mg/kg IV o IV (Maximum 600 mg) |

† *The total dose in children should not surpass the adult dose; follow-up doses one-half the initial dose.*
* *Cephalosporins should not be used in patients with type I penicillin hypersensitivity reaction (rash, angioedema or anaphylaxis).*
*VO: orally; IM: intramuscular; IV: intravenous.*

**Figure 3; ENDOCARDITIS-PROPHYLAXIS-RECOMMENDATIONS**

**a. Angina pectoris:**

It is a myocardial ischemia resulting from imbalance between coronary blood flow and oxygen demand. **[24]** It is a symptom complex with recurring seizures of pain and distress. Constricted by spasm, narrowed by coronary sclerosis, or occluded by a thrombus, the coronary blood supply becomes inadequate, resulting in altered myocardial metabolism and pain. The heart muscle being overtaxed experiences an oxygen deficiency and an accumulation of metabolic products which is believed to be the cause of painful symptoms. The pain of angina pectoris may be severe and agonizing; it maybe felt as a generalized pressure over the chest or under the sternum. It may also be felt in the teeth, lower jaw, clavical and shoulders, radiating down the left or both arms. **[1-9, 21,22,25]**

**b. Acute myocardial infarction (AMI):**

According to **Cruz-Pamplona M,etl.** . **[25]**acute myocardial infarction is characterized by acute, sudden onset and intense pain, of an oppressive nature, located in the retrosternal or precordial region, and can irradiate to the arms, neck, back, jaw, palate or tongue. The duration is over half an hour, and the pain does not subside with rest. The condition is accompanied by intense perspiration, nausea, vomiting, dyspnea and imminent death sensation, though it can also manifest as sudden loss of consciousness, mental confusion or weakness. . **[24,25]** The triggering stimuli are emotional stress, intense physical exercise or the existence of concomitant disease or surgery. So-called silent infarctions in turn are characterized by an absence of pain, and are more common in elderly individuals, in women and in diabetic patients. The drugs used to treat AMI and administered for secondary prevention purposes comprise beta-blockers, calcium antagonists and the angiotensin-converting enzyme inhibitors (ACEIs).[**1,25**] Figure 2

**Dental management:** A patient who has suffered acute myocardial infarction is at a high risk of suffering another infarction episode or severe arrhythmias. In dental practice a minimum safety period of 6 months has been established before any oral surgical procedure can be carriedout. In this time, dental treatment should be limited to emergency procedures aimed at affording pain relief: extractions, the drainage of abscesses and pulpectomies, preferably carried out in the hospital setting. After this safety period, the treatment decision should be established on the basis of the situation and medical condition of each individual patient. Figure 8 If the patient is receiving anticoagulants, the international normalized ratio (INR) on the day of treatment should be determined, and treatment should be provided within the recommended limits (< 3.5), with local hemostasis if surgery is planned. If the patient is receiving antiplatelet medication, excessive local bleeding is to be controlled. The local hemostatic measures that can be used comprise bone wax, sutures, gelatin of animal origin (Gelfoam ), regenerated oxidized cellulose (Surgicel ), collagen, platelet rich plasma, thrombin (Thrombostat ), fibrin sealants (Tissucol ), electric or laser scalpels, antifibrinolytic agents such as tranexamic acid (Amchafibrin ) or epsilon-aminocaproic acid (Caproamin ). [**1-17**]

**c. Arrhythmias:**

Arrhythmias are variations in normal heart rate due to cardiac rhythm, frequency or contraction disorders. Atrial fibrillation is the mostcommon type of cardiac arrhythmia, with a prevalence in the general population of 0.4%, though this percentage increases to 3.8% at 60 years of age and reaches 9% in individuals over 80 years of age. The frequency of electric pulse generation in the sinusnode ranges from 60-80 beats per minute (bpm) under resting conditions and can increase to 200 bpm during physical exercise. Arrhythmias are generated when electric pulse generation proves defective.

**Dental management**: Consultation with the supervising physician is advised in order to know the current condition of the patient and the type of arrhythmia involved, as well as the medication prescribed. It must be checked that the patient uses the medication correctly. Anxiolytics can be used to lessen stress and anxiety. Short visits in the morning are to be preferred. . **[ 1-19]** Patient monitoring, with recording of the pulse, is indicated before starting treatment. It is very important to limit the use of a vasoconstrictor in local anesthesia, with the administration of no more than two carpules. The treatment planned should not be too long or complicated. Although modern pacemakers are more resistant to electromagnetic interferences, caution is required when using electrical devices (e.g., ultrasound and electric scalpels) that might interfere with pacemakers –particularly the older models, since most such devices developed in the last 30 years are bipolar and are generally not affected by the small electromagnetic fields generated by dental equipment. It is therefore important to know the type of pacemaker, the degree of electromagnetic protection of the generator, and the nature of the arrhythmia. Pacemakers and automatic defibrillators pose a low risk of infectious endocarditis, and do not need antibiotic coverage before dental treatment. If important arrhythmia develops during dental treatment, the procedure should be suspended, oxygen is to be provided, and the patient vital signs are to be assessed: body temperature (normal values: 35.5-37ºC), pulse (normal values: 60-100 bpm), respiratory frequency (normal values in adults: 14-20 cycles or respirations per minute), blood pressure (normal values: systolic blood pressure under 140 mmHg and diastolic blood pressure under 90 mmHg). Sublingual nitrites are to be administered in the event of chest pain. . **[25-32]** The patient should be placed in the Trendelenburg position, with vagal maneuvering where necessary (Valsalva maneuver, massage in the carotid pulse region, etc.). The dental team should be prepared for basic cardiopulmonary resuscitation and initiation of the emergency procedure for evacuation to a hospital center, if necessary**.[1]** Figure 2

**d. Heart failure (HF):**Heart failure (HF) is defined as the incapacity of the heart to function properly, pumping insufficient blood towards the tissues and leading to fluid accumulation within the lungs, liver and peripheral tissues. According to **Cruz-Pamplona M**, etl. **[25]** in Spain, heart failure causes about 19,000 deaths each year.The survival of the affected patients is limited, due to the aggravating factors and concomitant pathologies they typically present. Heart failure in turn is the end stage of other diseases such as ischemic heart disease or arterial hypertension. Acute heart failure is triggered by cardiotoxic drugs or coronary occlusion episodes. The most common causes are severe and prolonged arterial hypertension, valve disease, ischemic heart disease and serious pericardial diseases. Acute heart failure typically manifests as acute lung edema. Chronic heart failure in turn is associated to antecedents of arterial hypertension and ischemic heart disease. Other causes are dilated myocardiopathy, valve disease, alcohol-induced heart disease, cor pulmonale and hypertrophic and restrictive myocardiopathy.Diabetes mellitus in turn leads to a 2.5-to 5-fold increase in the risk of developing chronic heart failure. The management of these patients includes identification and correction of the causal factors (e.g., arterial hypertension or valve disease), andchanges in lifestyle (elimination of toxic habits or modifications in diet). Drug treatment in the form of ACEIs (captopril, enalapril, lisinopril and quinapril) in turn can be associated to diuretics (furosemide) and vasodilators (isosorbide dinitrate and hydralazine). **[1-25]**

**Dental management:** Consultation with the supervising physician is advised in order to know the current condition of the patient and the medication prescribed. The patient should be receiving medical care, and heart failure should be compensated. Dental treatment is to be limited to patients who are in stable condition, since these individuals are at an important risk of developing serious arrhythmias and even sudden death secondary to cardiopulmonary arrest. In patients with heart failure,including those presenting palpitations, asthenia or dyspnea, it is important to only provide emergency care, and to do so in the hospital setting. Anxiety and stress are to be avoided during the visits, which in turn should be brief (less than 30 minutes) and are to be programmed for

the morning hours. The patient should be placed in the semi-supine position in a chair, with control of body movements (which should be slow), in order to avoid orthostatic hypotension. In patients administered digitalis agents (digoxin, methyldigoxin), the vasoconstrictor dose is to be limited to two anesthetic carpules, since this drug combination can favor the appearance of arrhythmias. Figure 3

**Medications Used to Treat Heart Failure;**

Digitalis is a Cardiac Glycoside. Mechanism of action:

**Digitalis binds to and inhibits**:

-The Magnesium and Adenosine Triphosphate dependent Sodium and Potassium ATPase; -This increases the influx of Calcium ions;

-This in turn enhances myocardial contractility.

**Digitalis and the AAA Guidelines**

1. Avoid with Digitalis:

-NSAIDS: Decrease renal clearance of Digitalis; Macrolides and Tetracycline: Increase serum levels of Digitalis, causing toxicity.

2. Use with Digitalis:

-Anesthetic:Mepivacaine;Analgesics:Acetaminophen,Acetaminophen+Codeine, Acetaminophen+Hydrocodone,Acetaminophen+Oxycodone;Antibiotics:Penicillins, Cephalosporins, Clindamycin.

Aspirin (acetylsalicylic acid) can lead to sodium and fluid retention, and therefore should not be prescribed in patients with heart failure. In the event of an emergency (i.e., lung edema), and after contacting the emergency service, the patient should be placed seated with the legs lowered, and receiving nasal oxygen at a rate of 4-6 liters/minute. Sublingual nitroglycerin tablets are indicated (0.4-0.8 mg), and the dose may be repeated every 5 or 10 minutes if blood pressure is maintained**.[35]** Acute lung edema manifests as sudden onset or progressive dyspnea, cough with expectoration, cyanosis, skin coldness, intense perspirationand critically ill sensation. The patient typically refers suffocation and laryngeal irritation, and the condition may simulate an asthma attack. Figure 3

| BP Classification | Systolic Blood Pressure (mmHg) | Diastolic Blood Pressure (mmHg) |
|---|---|---|
| Normal | <120 | <80 |
| Pre-hypertension | 120 – 139 | 80 - 89 |
| Stage 1 Hypertension | 140-159 | 90-99 |
| Stage 2 Hypertension | ≥160 | ≥100 |
| Stage 3 Hypertension | ≥180 | ≥110 |

**Source**: Sixth and Seventh Reports of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (USA).

**Figure 4;Classification-of-Blood-Pressure-for-Adults-Aged-18-Years-and-Olde**

**e. Arterial hypertension (AHT):**

Arterial hypertension (AHT) is an important health problem due to its high incidence and prevalence in the general population and the associated increase in risk of suffering cardiovascular disease in the form of chest pain (angina), myocardial infarction and cerebrovascular events (e.g., stroke). Arterial hypertension affects 6-8% of the general population and is the most common cardiovascular risk factor in Spain, with a prevalence of over 40% in patients over 35 years of age. The blood pressure values considered to be normal were established by consensus as under 90 mmHg in thecase of diastolic pressure, and under 140 mmHg in the case of systolic pressure. The latest revision of the guides for the evaluation and management of arterial hypertension of the National Committee on the Prevention, Detection, Evaluation, and Treatmentof High Blood Pressure (JNC 7) introduced the term “pre-hypertension” in reference to people with a systolic blood pressure of 120-139 mmHg or with a diastolic blood pressure of 80-89 mmHg. Figure 4

**Dental management** : A well controlled hypertensive patients does not pose a risk in clinical practice. Consultation with the supervising physician is advisable in order to know the degree of hypertension control and the medication prescribed at that time. The patient is to be instructed to take his or her medication as usual on the day of dental treatment. Prior to such treatment, the patient blood pressure should be recorded, and if the values are found to be high, the visit should be postponed until adequate pressure control is achieved. It is preferable for the visits to be brief and in the morning. The prescription of anxiolytic agents may prove necessary in particularly anxious patients 5-10 mg of diazepam the night before and 1-2 hours before the appointment) before dental treatment, or alternatively sedation with nitrous oxide may be considered. A good local anesthetic technique should be performed, avoiding intravascular injection and using a maximum of two anesthetic carpules with vasoconstrictor. If more anesthesia is needed, it should be provided without vasoconstrictor. Absorbable suture are to be avoided with adrenalin. During treatment, sudden changes in body position should be avoided, as they can cause orthostatic hypotension as a side effect of the blood pressure lowering drugs. When the patient does not present good blood pressure control, it is best to refer him or her to the physician in order to ensure adequate control before dental treatment. In the case of emergency dental visits, treatment should be conservative, with the use of analgesics and antibiotics. Surgery is to be avoided until adequate blood pressure control has been secured. Certain nonsteroidal antiinflammatory drugs (NSAIDs), such as ibuprofen, indomethacin or the naproxen, can interact with antihypertensive drugs (beta-blockers, diuretics, ACEIs), thereby lowering their antihypertensive action. Normally more than five days of treatment with both types of drugs are required for interactions to manifest; as a result, NSAIDs should not be prescribed for longer than this five-day period.

1. **Local anesthesia with vasoconstrictor**: The existing controversy over the use of local anesthesia with a vasoconstrictor is explained by the possible adverse effects of these substances upon blood pressure and/or heart rate. However, different studies have shown that no significant increases in arterial pressure are induced by the use of anesthesia with a vasoconstrictor in dental treatments. Patients with cardiovascular disease are at a greater risk of massive endogenous adrenalin release secondary to deficient local anesthesia than of reaction to the small amount of vasoconstrictor used in local anesthetics. In effect, pain is responsible for endogenous catecholamine release, and this in turn can give rise tohemodynamic alterations. Pain control is essential during dental procedures, and epinephrine affords excellent bleeding control in the context of local anesthesia. Nevertheless, vasoconstrictor use should be limited, taking carenot to exceed 0.04 mg of adrenaline (2 carpules containing 1.8 ml of anesthetic with adrenalin 1: 100,000).

2. Hypertensive emergencies: In the case of a hypertensive emergency (>120/210 mmHg), furosemide should be administered (40 mg, via the oral route). If this proves insufficient to restore pressure control, captopril should be administered (25 mg via the oral or sublingual route). If the blood pressure fails to decrease within 30 minutes after these measures, the patient should be referred to the nearest Hospital Emergency Department. Figure 4

All patients with cardiovascular disease can be managed using the following guidelines (According to **Waters BG.) [26];**

1. Properly assess the patient. This should include an assessment by the dentist and also a medical consultation if required;

2. Establish what medications the patient is taking along with the dose and timing and note any potential drug interactions and side effects;

2. Use short appointments (less than one hour), preferably in the morning;

3. Premedication should be considered to alleviate anxiety. The intraoperative use of nitrous oxide and oxygen is also a reasonable strategy for patients with cardiovascular disease, particularly those with ischemic heart disease;

4. Effective local anesthesia is important in order to avoid undue stress during the appointment as long as the guidelines for the administration of epinephrine are followed. The use of epinephrine impregnated gingival displacement cord should be strictly avoided in patients with cardiovascular disease;

5. For patients with angina pectoris, a fresh supply of nitroglycerin should be available at the time of the appointment. Prophylactic nitroglycerin has been shown to be effective in the prevention of both hypertension and angina pectoris during dental treatment. The appointment should be terminated early if the patient becomes overly anxious. In the event of cardiovascular symptoms during dental treatment, all work should be stopped. Emergency measures should be instituted if necessary. Preparations for emergencies should be undertaken by all dentists. **[1-22]**The treatment of patients with cardiovascular disease is relatively simple if the proper steps are taken. The use of blood pressure measurements on all patients will help to screen for undiagnosed hypertension and all patients who are potentially hypertensiveshould be referred for medical evaluation. A preventive approach to the treatment of these patients will serve to prevent untoward outcomes and provide safe and simple delivery of dental care for cardiovascular patients. **[22-37]** Figure 4

**f. Prevention of Bacterial Endocarditis**

**Infectious endocarditis (IE)**is an infrequent condition resulting from the association of morphological alterations of the heart and bacteremia of different origins. It has been estimated that 14-20% of all cases of IE have a buccodental origin. Transient bacteremia is observed not only in dental treatments such as tooth extractions (51-85%) or periodontal surgery (36-88%), but also during tooth brushing (26%) or when chewing gum (17-51%). The mortality rate is 5-11%. Approximately 50% of all cases of infectious endocarditis are caused by Streptococcus viridians. Infectious endocarditis is infrequent in young individuals, except intravenous drug abusers, which represent a high risk group. In these latter subjects, infectious endocarditis is a serious problem, with an estimated incidence of 1.5-3.3 per 1000 intravenous drug abusers, and an associated 5-10% mortality rate. These figures are decreasing, however, probably as a result of changing habits aimed at avoiding infection with the human immunodeficiency virus (HIV). Recurrent infectious endocarditis is also commonly observed in these individuals. 10

The guidelines are meant to aid practitioners, but are not intended as the standard of care or as a substitute for clinical judgment. The recommendations were formulated by the writing group after specific therapeutic regimens were discussed. The consensus statement was subsequently reviewed by outside experts not affiliated with the writing group and by the Science Advisory and Coordinating Committee of the American Heart Association. Figure 5

Major changes in the updated recommendations include the following:

a) emphasis that most cases of endocarditis are not attributable to an invasive procedure;

b) cardiac conditions are stratified into high, moderate, and negligible risk categories based on potential outcome if endocarditis develops;

c) procedures that may cause bacteremia and for which prophylaxis is recommended are more clearly specified;

d) an algorithm was developed to more clearly definewhen prophylaxis is recommended for patients with mitral valve prolapse;

e) for oral/dental procedures the initial amoxicillin dose is reduced to 2 g, a follow-up antibiotic dose is no longer recommended, erythromycin is no longer recommended for penicillin-allergic individuals but clindamycin and other alternatives are offered;

f) for gastrointestinal and genitourinary (GI/GU)procedures,the prophylactic regimens have been simplified. These changes were instituted to more clearly define when prophylaxis is/is not recommended, improve practitioner and patient compliance, reduce cost and potential GI side-effects, and approach more uniform world-wide recommendations.

Cardiac conditions for which prophylaxis is or is not recommended (Source:Protocols for dental management of the medically compromised patient. http://dentalclinicmanual.com/docs/medicallycompromisedpatients.pdf24):

1. **High Risk Category:** Prosthetic cardiac valves, including bioprosthetic and homograft valves; Previous bacterial endocarditis; Complex cyanotic congenital heart disease (e.g. single ventricle states; transposition of the great arteries, tetralogy of Fallot); Surgically constructed systemic-pulmonary shunts or conduits.

2. **Moderate Risk Category**: Most other congenital cardiac malformations (other than above and below); Acquired valvar dysfunction (e.g., rheumatic heart disease); Hypertrophic cardiomyopathy; Mitral valve prolapse with valvar regurgitation and/or thickened leaflets Endocarditis Prophylaxis Not Recommended Negligible Risk Category (No Greater Risk than the General Population); Isolated secundum atrial septal defect; Surgical repair of atrial septal defect, ventricular septal defect, or patent ductus arteriosus (without residua beyond 6 mo); Previous coronary artery bypass graft surgery; Mitral valve prolapse without valvar regurgitation; Physiologic, functional, or innocent heart murmurs; Previous Kawasaki disease without valvar dysfunction; Previous rheumatic fever without valvar dysfunction; Cardiac pacemakers (intravascular and epicardial) and implanted defibrillators. Figure 5

| Prophylaxis indicated | Prophylaxis not indicated |
|---|---|
| Prosthetic cardiac valves | Atrial septic defects |
| Previous infective endocarditis | Ventricular septal defects |
| Unrepaired cyanotic congenital heart disease, including palliative shunts and conduits | Patent ductus arteriosus |
| Completely repaired congenital heart defect with prosthetic material or device, during the first six months after the procedure | Mitral valve prolapse |
| Repaired congenital heart disease with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization) | Previous Kawasaki disease |
| Cardiac transplant recipients with cardiac valvulopathy | Hypertrophic cardiomyopathy |
| Rheumatic heart disease if prosthetic valves or prosthetic material used in valve repair | Previous coronary artery bypass graft surgery |
| | Cardiac pacemakers (intravascular and epicardial) and implanted defibrillators |
| | Bicuspid aortic valves |
| | Coarctation of the aorta |
| | Calcified aortic stenosis |
| | Pulmonic stenosis |

**Figure 5; Indications for prophylaxis against infective endocarditis in patients**

Dental procedures for which prophylaxis is or is not recommended:

**-Endocarditis Prophylaxis Recommended;**

1. Dental extractions;

2. Periodontal procedures including surgery, scaling and root planing, probing, recall maintenance; Dental implant placement and reimplantation of avulsed teeth;

3. Endodontic (root canal) instrumentation or surgery only beyond the apex;

4. Subgingival placement of antibiotic fibers/strips;

5. Initial placement of orthodontic bands but not brackets;

6. Intraligamentary local anesthetic injections;

7. Prophylactic cleaning of teeth or implants where bleeding is anticipated

**-Endocarditis Prophylaxis Not Recommended**:

1. Restorative dentistry2(operative and prosthodontic) with/without retraction cord3;

2. Local anesthetic injections (nonintraligamentary);

3. Intracanal endodontic treatment; post placement and buildup;

4. Placement of rubber dams;

5. Postoperative suture removal;

6. Placement of removable prosthodontic/orthodontic appliances;

7. Taking of oral impressions;

8. Fluoride treatments;

9. Taking of oral radiographs;

10. Orthodontic appliance adjustment;

11. Shedding of primary teeth.

**Prophylaxis Recommended;**

**1.**Prophylaxis is recommended for patients with high and moderate risk cardiac conditions.

**2.**This includes restoration of decayed teeth (filling cavities) and replacement of missing teeth

**3.**Clinical judgment may indicate antibiotic use in selected circumstances that may create significant bleeding

**g. Prophylaxis against total joint replacement infection;**

Patients who have undergone total replacement of a joint with a prosthetic joint may be at risk for hematogenous spread of bacteria and subsequent infection. These late prosthetic joint infections result in severe morbidity because the implant is usually lost when infections occur. There has been great concern that the bacteremia caused by tooth extraction may result in such infections. However, the recent literature suggests that bacteremias from oral procedures are not likely to cause prosthetic joint infections. It appears that the bacteremia after oral surgery is of a transient nature and does not expose the implant and periimplant tissues to bacteria long enough to cause infection.

In 2003 the American Dental Association (ADA) and the American Academy of Orthopaedic Surgeons (AAOS) issued a revised joint recommendation concerning the management of patients with prosthetic total joints. In 2009, the American Academy of Orthopaedic Surgeons issued an advisory statement recommending that all patients with prosthetic joints receive antibiotic prophylaxis before dental procedures, regardless of the length of time following implantation. Figure 6

This disorder is characterized by the inflammation of the endothelium, which is the inner lining of the heart and blood vessels with the capacity to affect many surfaces that are covered by endothelial cells, such as the ventricles, atria, and pulmonary arteries with the cardiac valves have a specific susceptibility . The correlation between infective endocarditis and orthodontics has not been fully elucidated. The committee of the American Heart Association determined that there is no substantial risk of bacteraemia associated with the manipulation of orthodontic appliances. Therefore, it is not advisable to routinely administer prophylaxis for the purpose of adjusting detachable or fixed orthodontic appliances or bonding orthodontic brackets . It is advisable to administer prophylaxis for orthodontic procedures that have the potential to cause perforation of the oral mucosa or manipulation of gingival tissues. The procedures encompassed in this category consist of the implantation and removal of orthodontic bands, interproximal reduction, as well as the insertion of temporary anchorage devices . In order to minimize any adverse effect during orthodontic treatment in patient with infective endocarditis, it is advisable to engage in consultation with the patient's physician in order to assess the amount of risk and establish an appropriate antibiotic prescription in accordance with the planned orthodontic treatment . It is imperative to adhere to a rigorous oral hygiene protocol during the course of treatment. In addition, it is advisable to go for bonded brackets as opposed to bands, elastomeric ties are considered to be a more favorable option compared to ligature ties for the purpose of securing arch wires in position. It is recommended that any sharp edges, including those found on tubes and hooks, be appropriately softened and polished. It is advisable to eliminate and cleanse any surplus adhesives. It is recommended to refrain from using fixed acrylic equipment, such as Nance and acrylic fast maxillary expanders .

**The 3 recommendations of the American Dental Association and the American Academy of Orthopaedic Surgeons are**:

1. The practitioner might consider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures . Figure 6

2. We are unable to recommend for or against the use of topical oral antimicrobials in patients with prosthetic joint implants

or other orthopaedic implants undergoing dental procedures.

3. In the absence of reliable evidence linking poor oral health to prosthetic joint infection, it is the opinion of the work group that patients with prosthetic joint implants or other orthopaedic implants maintain appropriate oral hygiene.

The first recommendation is classified as limited because the limited amount of currently available reliable scientific evidence does not substantiate that dental procedures cause late prosthetic joint infections. **.[1-22]**

The second recommendation is classified as inconclusive because the studies performed to date have come to inconsistent conclusions, from which no clear recommendation can be generated.

The third recommendation is based upon the consensus of the expert panel, rather than on any scientific studies**.[1-15 ]**

## 3. DISCUSSION

Dental treatment is often associated with pain, fear,and anxiety. Stress and anxiety may lead to exaggerated endogenous catecholamine release from the adrenal medulla, causing hemodynamic disturbances .[**38]**

In patients with underlying cardiovascular pathologies like hypertensive heart disease, ischemic heart disease, arrhythmias, o heart transplantation patients, inadequate local anesthesia may cause massive endogenous adrenaline release provoking cardiovascular complications. So, pain control and stress reduction are essential for patients undergoing dental treatment, particularly those with underlying cardiac disease. [**1,35]**

Local anesthetics with vasoconstrictors (like epinephrine) in dentistry impart prolonged anesthesia, reduced systemic toxicity, and optimal bleeding control

**[ 40,41].** Though the use of epinephrine in local anesthetics is common for healthy patients, its use is still debatable for cardiac patients due to its potential risk

of causing unwanted cardiovascular effects. However, many authors have reported no clinically significant hemodynamic changes during dental treatment in healthy

people or patients with mild to moderate coronary disease[**22, 41–44**].

The dose of vasoconstrictor used in dental treatment is significantly less than the dose used during the treatment of anaphylaxis for cardiac arrest. For example, one

cartridge of local anesthetic of 1.8 mL in volume with 1:100,000 epinephrine contains only 0.018 mg of vasoconstrictor [**45**]. This small amount of vasoconstrictor used in dentistry poses little risk than the more significant risk from

the massive endogenous epinephrine release due to improper control of pain and anxiety during dental treatment in cardiac patients. Thus, if administered carefully with aspiration, the concentration and amount of vasoconstrictor used in dentistry are generally not contraindicated for cardiac patients. However, it is better to use the lowest possible dose of vasoconstrictor to achieve adequate local anesthesia

while treating patients with “stable” cardiac problems. Therefore, up to 0.04 mg or 40 $\mu$g of epinephrine, i.e., one or two carpules of 1.8 mL anesthetic solution with

epinephrine 1:100,000 concentration is safe for controlled hypertensives and/or coronary disease patients [**22,45**] Figure 6

| Clinical situation | Medication | Single dose 30-60 minutes pre-procedure | |
|---|---|---|---|
| | | Adults | Children |
| Person able to take oral medication | amoxicillin | 2 g | 50 mg/kg |
| Person unable to take oral medication | ampicillin | 2 g IM[i] or IV[ii] | 50 mg/kg IM/IV |
| | cefazolin | 1 g IM or IV | 50 mg/kg IM or IV |
| | ceftriaxone | 1 g IM or IV | 50 mg/kg IM or IV |
| Person allergic to penicillins or ampicillin but able to take oral medication[iv] | cephalexin[iii/v] | 2 g | 50 mg/kg |
| | azithromycin | 500 mg | 15 mg/kg |
| | clarithromycin | 500 mg | 15 mg/kg |
| | doxycycline | 100 mg | <45 kg, 4.4 mg/kg<br>>45 kg, 100mg |
| Person allergic to penicillins or ampicillin and unable to take oral medication | cefazolin | 1 g IM or IV | 50 mg/kg IM or IV |
| | ceftriaxone[v] | 1 g IM or IV | 50 mg/kg IM or IV |

**Figure 6; Infective Endocarditis, Heart Conditions**

**Heart conditions that contraindicate the use of vasoconstrictors in dentistryinclude** [**46**]:

(a) Unstable angina

(b) Recent myocardial infarction

(c) Recent coronary artery bypass surgery

(d) Refractory arrhythmias

(e) Untreated or uncontrolled severe hypertension

(f) Untreated or uncontrolled congestive heart failure

Also, it is contraindicated to use epinephrine impregnated retraction cords, intraligamentary, and intrabony injections in these patients due to adverse hydrodynamic effects similar to I.V. epinephrine injection [**46]**. Though local

anesthetics can lead to a decrease in the rate of amide metabolism in hypertensive patients taking beta-blockers [**15**], generally non-epinephrine-containing local anesthetics do not have significant drug interactions [**47**]. Drug interactions mostly stem from the incorporated vasoconstrictor [**47**]. For example, epinephrine can interact with commonly used antihypertensives like non-selective betablockers causing significant hypertensive episodes [**48**] and reflex bradycardia [**15**]. Though the response is dosedependent and rarely seen in dental clinics, the dentist must be careful in using vasoconstrictors in patients with significant cardiac disease due to the serious sequelae of this drug combination. Agents like clonidine [**49]** and dexmedetomidine [**50**] can be used as safer alternatives to epinephrine with the local anesthetic solution in hypertensive patients. In such patients, it can also be prudent to use lidocaine, prilocaine, and mepivacaine solutions without vasoconstrictor [**51**].

In patients who require urgent or emergent cardiac surgery, the need for a dental intervention should be discussed by all members of the heart team including cardiology, cardiac surgery, and anesthesia in consultation with the dental service. Important factors to be evaluated include the severity of both the underlying cardiovascular and dental disease, the time necessary for any dental intervention, and what if any alternative, less invasive procedures can be performed to temporize the dental issues. .[**46-54**]

An important issue is how long one has to wait after an extraction, or any other dental procedure, to undergo cardiac surgery. Based on studies showing duration of bacteremia post-dental intervention, the recommendation is to wait at least 24 h after dental treatment before proceeding with a medical intervention in these patients.[47,53] Most studies have shown that following tooth extractions, bacteria is present in the majority of blood cultures[**12,35,47,54**] but significantly decreases 10-60 min after dental interventions.[**55–57** ]In rare cases, it was possible to detect positive blood cultures up to 24 h.[**47**] However, several authors have reported no differences in adverse outcomes in patients who had their dental procedures performed before or concomitantly with the cardiac surgery. Although not based on scientific evidence, the American College of Cardiology recommends that “individuals at risk of developing bacterial endocarditis should observethe best hygiene possible”. Other authors consider that maintaining good oral health is probably more important for the prevention of endocarditis than the prophylactic administration of antibiotics before certain dental operations .**[49-54]**

It has been seen that bacteremia may develop after traumatic ulcer formation associated with removable dentures.Periodic controls are thus advised to prevent them from developing **.[52]**

Some investigators such as Blanco in 2004 consider that it is advisable to perform rinses with 0.12% chlorhexidine for at least 30 seconds, before any dental treatment, since this produces an important reduction in bacteremia of oral origin**.[52,53]**

If the patient has failed to correctly follow the prophylactic treatment regimen, antibiotics are to be administered as soon as possible, since this has been shown to be effective when carried out in the two hours following the development of bacteremia **.[52]** Figure 7

| INR | Frequency | Percentage |
|---|---|---|
| <1.5 | 309 | 96.0% |
| >1.5 | 13 | 4.0% |
| Total | 322 | 100.0% |

INR: International normalized ratio

**Figure 7; INR levels and their frequencies**

Anticoagulant therapy or antithrombotic therapy has been used widely to manage various cardiovascular conditions including myocardial infarction, stroke, and deep vein thrombosis [**55**]. Figure 8 The patients on anticoagulant therapy should be handled with proper care and in consultation with the patient’s physician. The patients on anticoagulant medication and undergoing a dental procedure that involves low to medium risk of bleeding can be effectively managed by local hemostatic measures.guidelines do not suggest the cessation of antiplatelet therapy for procedures involving a low risk of bleeding [**55-**

**58**]

The ratio of the patient prothrombin time to the mean prothrombin time raised to the power of international sensitivity index (ISI) value is the INR of the patient. It determines the anticoagulation status of a patient [ **55**]. Figure 8.

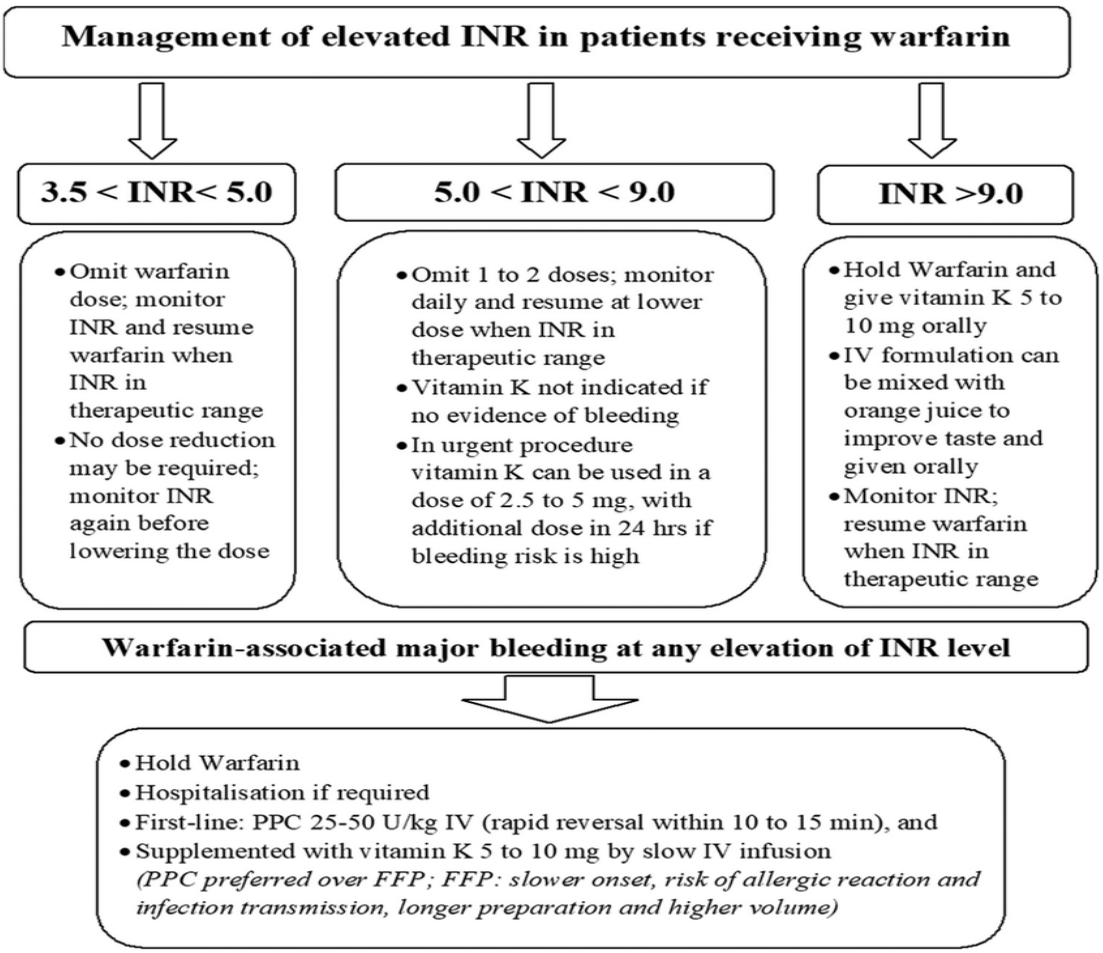


**Figure 8; Management algorithm for reversal elevated INR with or without bleeding . INR = International normalized ratio; PCC = Prothrombin complex concentrate; FFP = Fresh frozen plasma**

It is recommended to check the INR 72 hours prior to an invasive dental procedure in a patient taking long-term anticoagulant therapy and stably anticoagulated on warfarin [58]. A physiologically normal patient has an INR value of 1, and a therapeutic range of 2.0 to 3.0 is considered safe for most indications due to the reduced risk of thromboembolic events [ **56**]. In the case of prosthetic heart valves, a higher INR range of 2.5–3.5 is required [ **57**]. Guidelines on the management of patients on oral anticoagulant therapy (2007) recommend not to discontinue the anticoagulants in patients with stable INR in the range of 2.0–4.0 as the risk of significant bleeding is low for most outpatient dental procedures [**56**]. American Academy of Oral Medicine (AAOM) Clinical Practice Statement 2016 stated that an INR value of 3.5 (up to 4.0 by some experts) is safe for moderately invasive dental surgical procedures like simple tooth extractions . For non-invasive dental procedures, there is no need to maintain this safety margin [**55-58**].

## 4. CONCLUSION

Cardiovascular diseases (CVD) comprise of a group of diseases of the heart and vascular system affecting majority of individuals worldwide. Dental surgeons may be the first line of defence in the detection and referral of a patient suspected of having cardiovascular disease, an uncontrolled disease status, or oral adverse drug reactions, and they have a key role to play in oral and systemic disease prevention and treatment, in partnership with the patient and his physician.

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