



Major evidence of the relationship of cardiovascular disease and tooth extraction: a systematic review

Maria Angélica Tognolo^{1,2}, Taise Pianesso^{1,2}, Heloísa Soler Gomes^{1,2},
Andreia Borges Scriboni^{1,2*}

¹ UNORTE - University Center of Northern São Paulo, Dentistry department, São José do Rio Preto, São Paulo, Brazil.

² UNIPOS - Post graduate and continuing education, Dentistry department, São José do Rio Preto, São Paulo, Brazil.

*Corresponding author: Dr. Andreia Borges Scriboni.

Unorte/Unipos - Postgraduate and continuing education,

Sao Jose do Rio Preto, Sao Paulo, Brazil.

E-mail: andrea.scriboni@unorte.edu.br

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Abstract

Introduction: Cardiovascular diseases can present a congenital origin, that is present from birth, such as interatrial and interventricular communication, defects of the artery, coronary arteries, or acquired coronary artery anomalies that involve several risk factors such as smoking, alcohol, old age, and sedentary lifestyle. Thus, the acquired ones are the most frequent in the routine of a dental practice, so the dentist should be able to attend to those patients who need special care, regarding the correct use of medications due to the risk of drug interactions, the type of local anesthetic to be used and the management of patients who use anticoagulant therapy. **Objective:** It was to develop a concise systematic review to highlight the main clinical outcomes of the relationship between cardiovascular diseases and tooth extraction. **Methods:** The research and development of the work were carried out from December 2023 to February 2024 in the databases Scopus, PubMed, Science Direct, and Scielo, following the PRISMA rules. The quality of the studies was based on the GRADE instrument and the risk of bias was based on the Cochrane instrument (Funnel Plot). **Results and Conclusion:** A total of 112 studies were found that were subjected to eligibility analysis. The final sample had 36 eligible studies and 21 studies were described in the systematic review. Most studies showed homogeneity in their results, with $X^2 = 63.9\% > 50\%$, with $p < 0.05$. It was concluded that the virtual reality technique was effective in controlling blood pressure and heart rate within an acceptable range and can help in the management of blood pressure and heart rate

during tooth extraction in patients with hypertension. It is necessary for the dental treatment of these patients with heart disease a good knowledge of the subject and requires medical and dental coordination. Dental surgeons need to be prepared to identify possible medical and dental emergencies and take steps to prevent or treat them effectively and quickly.

Keywords: Cardiovascular diseases. Tooth extraction. Dental treatments. Prevention.

Introduction

The correct evaluation of patients with cardiovascular impairment is based on a detailed anamnesis and prior knowledge of the main coronary disorders and their sequelae. Complications such as myocardial infarction and bacterial endocarditis may be described in clinical dental procedures. The management of this information is important in determining the patients' cardiac risk to classify it as high, moderate, or minimal [1].

Thus, the dental professional must plan the clinical consultations according to the pre-established individual risk [1,2]. Short-term consultations and limitation of stress and anxiety levels, with the use of anti-anxiolytic drugs and complementary sedation, may be important for an uncomplicated trans and postoperative period. Emergency procedures, in cases where coronary changes occur during a clinical procedure, are also evident [2].

In this context, cardiovascular diseases can present a congenital origin, that is present from birth, such as

interatrial and interventricular communication, defects of the artery, coronary arteries, or acquired coronary artery anomalies that involve several risk factors such as smoking, alcohol, old age, sedentary lifestyle, which contribute to the aggravation of these diseases Hypertension, atherosclerosis, arrhythmia, angina pectoris, myocardial infarction, heart failure, stroke [1-5].

Thus, the acquired ones are the most frequent in the routine of a dental practice, so the dentist should be able to attend to those patients who need special care, regarding the correct use of medications due to the risk of drug interactions, the type of local anesthetic to be used and the management of patients who use anticoagulant therapy [6].

In dentistry, we have surgical procedures such as the extraction of supernumerary teeth, removal of third molars, wisdom teeth, and residual root, with or without odontostomy and osteotomy, which, because they are more complex procedures, cover even more care in patients with heart disease, especially in the preoperative, in the trans-operative and the postoperative period, so all care is essential [1,7].

The recommendations of the American Heart Association emphasize that some surgical procedures, dental procedures, and instrumentations involving mucosal surfaces or contaminated tissues may cause transient bacteremia [8]. While recognizing that the efficacy of antibiotic protection is uncertain in some cases, it recommends the administration of antibiotics to patients with a potential risk of developing endocarditis. Continued administration of antibiotics should be considered in patients with established infection before the procedure. However, it is not possible to predict which patients will develop this infection or which particular procedure will be responsible [8,9].

Therefore, the present study developed a concise systematic review to highlight the main clinical outcomes of the relationship between cardiovascular diseases and tooth extraction.

Methods

Study Design

The present study followed the international systematic review model, following the rules of PRISMA (preferred reporting items for systematic reviews and meta-analysis). Available at: <http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1>. Accessed on: 02/17/2024. The methodological quality standards of AMSTAR-2 (Assessing the methodological quality of systematic reviews) were also followed. Available at: <https://amstar.ca/>. Accessed on: 02/17/2024.

Quality of Studies, Eligibility Criteria, and Risk of Bias

Following GRADE recommendations, the quality of scientific evidence in the studies covered was classified as high, moderate, low, or very low, according to the risk of evidence bias, sample size, clarity of comparisons, precision, and consistency of effects of the analyses. A high quality of evidence was assigned using four criteria: 1) Randomized or prospective controlled clinical trials; 2) Retrospective clinical trials; 3) Sample size greater than 15 participants; 4) Studies with statistically well-designed results; 5) Studies published in indexed journals and with a significant impact factor; 6) descriptive validity, interpretative, theoretical (credibility of the methods) and pragmatic).

The Cochrane Instrument was adopted to evaluate the risk of bias of the chosen studies using the Cohen Test to calculate the effect size (Effect Size) versus the Inverse of the Standard Error (precision or sample size) to determine the Risk of Bias of the studies using the Funnel Plot graph. The Heterogeneity Test (Chi-square Test, $25\% < X < 50\%$, and high association = $> 50\%$).

Data Sources, Research Strategy, and Study Timing

The search strategies for the present study were based on the keywords (MeSH Terms): *Cardiovascular diseases. Tooth extraction. Dental treatments. Prevention*. Search filters designated as clinical studies were used. The research and development of the work was carried out from December 2023 to February 2024 in the Scopus, PubMed, OVID, Science Direct, LILACS, and EBSCO databases. In addition, a combination of the words- key with the booleans "OR", AND and the "NOT" operator were used to target scientific articles of interest. The title and abstracts were examined in all conditions.

Results and Discussion

Summary of Literary Findings

A total of 112 articles were found. Initially, duplicate articles were excluded. After this process, the abstracts were evaluated and a new exclusion was carried out, removing articles that did not include the topic of this article, resulting in 82 articles. A total of 36 articles were fully evaluated and included in this study and 21 were developed into the systematic review item (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 24 studies with a high risk of bias and 22 studies that did not meet GRADE and AMSTAR-2. According to the GRADE instrument, the 21 studies that made up the systematic review presented homogeneity in their results, with $X^2 = 63.9\% > 50\%$,

with $p < 0.05$. Due to limited literature, an open search strategy was performed to include a larger number of studies.

Figure 1. Flowchart showing the article selection process.

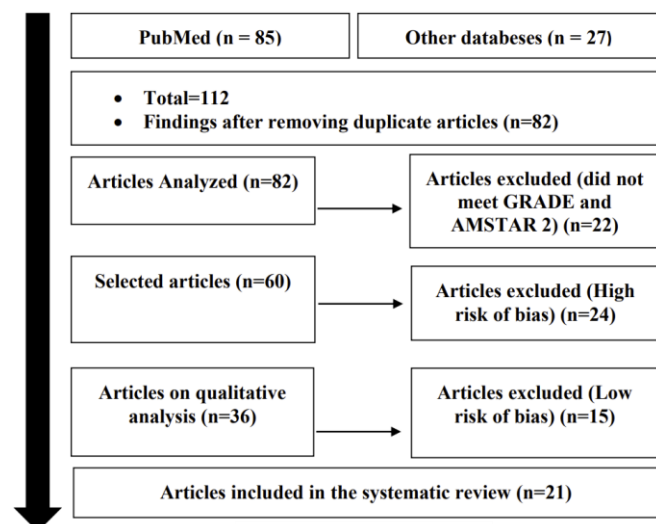
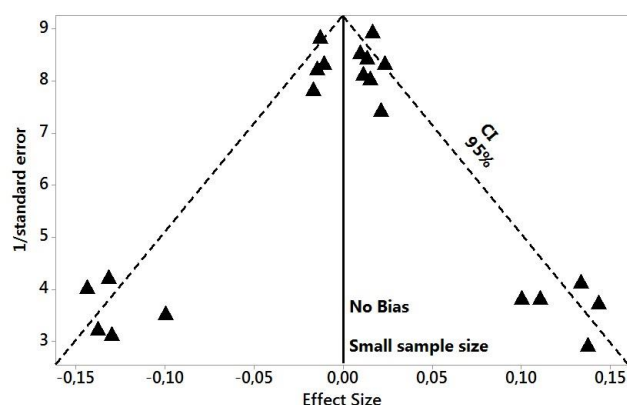


Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using the Cohen Test (d). The sample size was determined indirectly by the inverse of the standard error ($1/\text{Standard Error}$). This graph presented symmetrical behavior, not suggesting a significant risk of bias, both between studies with a small sample size (lower precision) that are shown at the base of the graph and in studies with a large sample size that are presented in the upper region.

Figure 2. The symmetric funnel plot suggests no risk of bias among the small sample size studies that are shown at the bottom of the plot. High confidence and high recommendation studies are shown above the graph (NTotal= 21 studies evaluated in full in the systematic review).



Major Findings

Tooth extraction is one of the most common causes of anxiety and dental pain, leading to elevated blood pressure (BP) and heart rate (HR). One study analyzed whether virtual reality can control elevated BP and HR in patients with hypertension. A total of 96 eligible patients with controlled hypertension who required tooth extraction were randomized to the virtual reality or standard treatment group by stratified randomization of anxiety level and gender. The results showed that the virtual reality technique significantly reduced the elevation of BP and HR, and this effect was found even after adjustment for baseline characteristics and additional surgical procedures. Virtual reality did not increase the incidence of adverse events. Therefore, the virtual reality technique was effective in controlling BP and HR within an acceptable range and can help in managing BP and HR during tooth extraction in patients with hypertension [10].

In all cases of patients with cardiovascular diseases, the preoperative anamnesis should be done with all the details, always observing the risk factors that progress to include the medications used, if the patient makes use of cardiac prostheses, monitoring the signs vital before and after dental procedures, always recording all occurrences and procedures in medical records [11-13].

Based on the recent study by Kamatani et al. (2017) [4], although cardiac arrhythmias are occasionally associated with dental extractions and dental anesthesia, an atrioventricular block is rarely seen during dental procedures. In this study, a rare case of type I second-degree atrioventricular block (Wenckebach's phenomenon) was reported after bilateral extraction of mandibular third molars retained under general anesthesia in a 16-year-old Japanese girl. Extubation of the nasotracheal tube or oral/pharyngeal suctioning could have triggered a vagal reflex that caused a type I second-degree atrioventricular block. Thus, standard cardiovascular monitoring is imperative for patients undergoing dental treatment under general anesthesia.

Still, according to Forrest et al. (2017) [5], a trigger for hereditary angioedema is dental treatment with tooth extraction. Clinical symptoms may not manifest for many hours or even days after the procedure. In the example of this author, the problem resulted in death after tooth extraction, highlighting the need for dentists to be aware of this condition.

In a review of episodes of bacterial endocarditis involving litigious procedures against dental surgeons, it was found that the dental procedures that resulted in bacterial endocarditis were tooth extraction, periodontal scaling, root canal treatment with over instrumentation, and minor oral surgery [14-16]. The authors observed

that the dentists involved in the cases failed to prescribe a prophylactic antibiotic therapy, prescribed incorrect antibiotics, or at inappropriate times. There was only one episode of correct antibiotic prophylaxis that resulted in bacterial endocarditis. These data highlight the importance of correct prophylaxis with antibiotics, as there is adequate evidence that this procedure reduces the risks of transient bacteremia. In addition, the dentist needs to record all procedures and behaviors in the patient's clinical record because, in any litigious proceedings, the medical record is the most reliable document used to defend the professional [1,14,15].

Regarding the use of anticoagulants and platelet anti-aggregates, patients with heart disease usually use acetylsalicylic acid medication, sodium warfarin that interferes with blood clotting, making it difficult to perform dental surgery. In this case, the dental surgeon must request a pre-operative laboratory test called a Coagulogram for International Normalization Ratio (INR), which is recommended by the World Health Organization (WHO) to unify the prothrombin time blood clotting tendency [1,2].

In addition, in the trans-operative, the dental surgeon must always be prepared with hemostatic measures: 10.0 mL tranexamic acid for irrigation, collagen sponge, and bone lock. In cases of bleeding, the patient should be referred to an outpatient clinic for intravenous administration of fresh frozen plasma and vitamin K (1mg) [3].

Regarding the use of vasoconstrictors, every cardiopathy patient is at greater risk of endogenous adrenaline release due to local anesthesia improperly than the small amount of local anesthetic use of vasoconstrictors in a small amount. The dental surgeon, however, cannot exceed the limit of 0.04mg adrenaline, and perform negative aspiration so that there is no intramuscular injection. In this context, anxiety is a factor that interferes with cardiovascular systemic homeostasis; in the preoperative period, the use of anxiolytics can be used [2,3].

In hypertensive patients, the disease is asymptomatic and defined as the elevation of blood pressure in the arteries, systolic pressure is the maximum pressure, while the diastolic pressure is the minimum, with values at rest above 140mmHg (systolic) and 90mmHg (diastolic), is considered a hypertensive individual [8]. Checking the pressure before the consultation, even if the patient is controlled, always opt for consultations in the morning, and are brief, to avoid the use of NSAIDs (non-steroidal anti-inflammatory drugs) for a long period and in patients who use the medications for pressure: propranolol and captopril, etc, as there may be interference in the mechanism of action of hypertensives [8].

In dentistry, the most used antibiotic prophylaxis is for the prevention of infective endocarditis. Infective endocarditis is a remote infection involving the heart valves and may lead to death [14,15]. Recent studies emphasize changes in the profile of infective endocarditis from a streptococcal disease in patients with prior heart disease to a staphylococcal disease associated with performing dental and medical procedures in elderly patients with multiple comorbidities [17].

In this sense, the American Heart Association (AHA) suggests the adoption of antibiotic prophylaxis for the prevention of infective endocarditis under certain conditions [17]. This therapeutic resource has now been indicated only for patients at high cardiac risk in invasive dental procedures. Thus, a restricted number of patients is selected, only those in whom endocarditis would lead to an increased risk of morbidity and mortality [17].

The indication of the use of antibiotic prophylaxis before invasive dental procedures is well established in patients with cardiovascular conditions predisposing to the development of infective endocarditis, such as patients with prosthetic heart valves or repaired with prosthetic material, previous history of endocarditis, cardiac transplantation that develops with dysfunction valvular heart disease, uncorrected or corrected cyanotic congenital heart disease, but evolved to the residual lesion, corrected with prosthetic material or device, during the first six months after the procedure, any corrected congenital heart disease with a residual defect at or adjacent to the prosthesis [18-20].

Some clinical conditions may predispose patients to the development of remote infection [20]. In these individuals, antibiotic prophylaxis is indicated and should be discussed with the attending physician, considering comorbidities and vulnerabilities. This includes patients with Acquired Immunodeficiency Syndrome-AIDS (CD4 <1,000 / mm³), in chemotherapeutic treatments, transplanted solid organs or bone marrow, in radiotherapy treatments of head and neck, using immunosuppressants, autoimmune disease, Skeletal anemia, splenectomy, use of bisphosphonates, injecting drug users, chronic renal failure, severe facial infection, chronic or active hepatitis, diabetes mellitus and patients with orthopedic joint prostheses [21].

Another important issue is the dosage of anesthesia, to avoid complications, the maximum dose of anesthetics must be respected. In those with severe risk, it is recommended that the physician in charge request anesthetics without vasoconstrictors to avoid undesirable complications, such as tachycardia and even cardiac arrest. This brings with it several disadvantages during the treatment because, in addition to decreasing the time of action of the drug,

due to the rapid leakage of the anesthetic components into the bloodstream, it provides a potential increase in systemic toxicity [2].

In the case of lidocaine, the maximum dose is 4.4 mg/kg or 300mg; mepivacaine is 4.4 mg/kg or 300mg; prilocaine is 6 mg/kg or 400mg; and articaine is 7 mg/kg or 500mg. Likewise, vasoconstrictors should be well-adjusted. Adrenaline, for example, has a maximum recommended dose of 0.2mg, while noradrenaline is 0.34mg per session [2,6].

The use of anesthetic prilocaine should be carefully monitored because doses above 600 mg may cause episodes of methemoglobinemia (Meta-hemoglobin is a form of hemoglobin protein, in which the iron in the heme group is in the Fe³⁺ state and not in Fe²⁺ of normal hemoglobin. In this disorder, iron atoms in the form of ferric ions lose the ability to release oxygen to tissues causing episodes of tachycardia, cyanosis, dyspnea, fatigue, headache, vomiting and dizziness, and may progress to coma and death. of this table can be obtained by intravenous administration of 1% methylene blue (1.5 mg/kg) [12].

In this context, in the case of endodontic procedures, it is also verified that the absence of hemostatic action promotes greater bleeding of the pulp tissue and less control of pain during treatment. In cases of stress, pain, and tension can generate an amount of endogenous adrenaline greater than that administered in local dental anesthesia when the correct dosage is respected. Thus, if the patient can tolerate the stress of the dental procedure, he may receive local anesthesia with a vasoconstrictor [12].

In this scenario, for the patient with a history of angina or previous myocardial infarction, every effort should be made to reduce stress levels through efficient and deep anesthesia for dental and soft tissue procedures. During the consultation with the patient's physician, the dental surgeon may report the intention to prescribe anxiolytic medication before the dental procedure. The prescription of anxiolytics and preventive medication for angina helps in the comfort and stability of the patient. Monitoring of blood pressure and heart rate should be performed during the procedure and for the next 30 minutes [7,12].

The dental care of patients with cardiovascular impairment requires correct planning of the clinical procedures to be performed. To this end, prior contacts with the patient's physician and a detailed anamnesis will provide crucial information for the determination of the risk factors. These will depend on the choice of care in the office or hospital setting and the determination of the need for antibiotic prophylaxis [12].

Thus, short-term visits and the use of complementary sedation may make the service safer

and more comfortable for both the patient and the professional. It is also worth remembering that the more informed and prepared the dentist is at the moment of the clinical consultation, the lower the chances of trans and postoperative complications. In addition, there will be more tranquility and speed to deal with possible emergencies, increasing the patient's chances of survival [21].

Conclusion

It was concluded that the virtual reality technique was effective in controlling blood pressure and heart rate within an acceptable range and can help in the management of blood pressure and heart rate during tooth extraction in patients with hypertension. It is necessary for the dental treatment of these patients with heart disease a good knowledge of the subject and requires medical and dental coordination. Dental surgeons need to be prepared to identify possible medical and dental emergencies and take steps to prevent or treat them effectively and quickly.

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Conflict of interest

The authors declare no conflict of interest.

Similarity check

It was applied by Ithenticate®.

Peer Review Process

It was performed.

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