DEVELOPMENT OF ENDOCARDITIS IN DENTISTRY AND THE IMPORTANCE OF ORAL HYGIENE: LITERATURE REVIEW

DESENVOLVIMENTO DA ENDOCARDITE EM ODONTOLOGIA E IMPORTÂNCIA DA HIGIENE ORAL: REVISÃO DE LITERATURA

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Resumo

A endocardite bacteriana (EB) apresenta-se como uma doença infecciosa que possui vários fatores etiológicos, dentre eles a constante presença de bactérias orais nessa patologia. Dada a presente relação e a relevância do assunto, é fundamental que o cirurgião-dentista aprofunde os conhecimentos a esse respeito. Em vista disso, o objetivo do estudo é realizar uma revisão de literatura sobre o mecanismo de desenvolvimento da EB e sua relação com a higiene oral. Foram realizadas pesquisas nas bases de dados PubMed, EMBASE e Biblioteca Virtual em Saúde (BVS), utilizando os descritores anteriormente selecionados das plataformas MeSH e DeCs. Após as buscas, foram selecionados 9 artigos para compor a revisão de literatura. Inicialmente foi realizada a análise de títulos e resumos, e, posteriormente, leitura na íntegra. Os achados mostram que a má higienização oral de indivíduos com desordens cardiovasculares pode se apresentar como um fator predisponente para o desenvolvimento da EB devido à interação dos microrganismos e mediadores pró-inflamatórios. Portanto, a compreensão de que a manutenção da higiene oral é fundamental para a redução do acúmulo e agregação microbiana e, consequentemente, EB, ressalta a importância de conhecer o assunto por parte de cirurgiões-dentistas, a fim de prevenir complicações e atuar preventivamente.

Palavras-chave: Bacteremia, Endocardite, Odontologia.

Abstract

Bacterial endocarditis (BE) is an infectious disease with several etiological factors, including the constant presence of oral bacteria. Given this relationship and the relevance of the subject, it is essential that dentists deepen their knowledge on this matter. Thus, the aim of the study is to conduct a literature review on the mechanism of BE development and its relationship with oral hygiene. Searches were conducted in the PubMed, EMBASE and Biblioteca Virtual em Saúde (BVS) platforms, using the descriptors previously selected from the MeSH and DeCS platforms. After analyzing their titles and abstracts and then read in full, nine articles were selected for the literature review. The findings show that poor oral hygiene in individuals with cardiovascular disorders may be a predisposing factor for the development of BE, due to the interaction of microorganisms and pro-inflammatory mediators. Therefore, the understanding that maintenance of oral hygiene is essential to reduce microbial accumulation and aggregation and, consequently, BE, highlights the importance of dentists knowing the subject to prevent complications and act preventively.

Keywords: *Bacteremia, Endocarditis, Dentistry.*

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INTRODUCTION

Infectious endocarditis (IE) is a substantial cause of morbidity and mortality in children and adolescents, despite developments in management and prophylaxis (1,2).This disease is an infection of the endocardial surface of the heart and can also occur in intracardiac devices caused by multiple etiological factors that can lead to death (1,3). IE includes acute and subacute bacterial endocarditis, as well as non-bacterial endocarditis caused by viruses, fungi, and other microbiological agents.

Bacterial endocarditis (BE) is the most worrisome IE in dentistry due to the presence of qualitatively and quantitatively distinct bacteria in the oral cavity (4). Most cases are caused by *Streptococcus viridans, Streptococcus gallolyticus*, *Staphylococcus aureus*, coagulase-negative staphylococci, HACEK organisms (*Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella, Kingella*) and enterococci. Rare organisms include pneumococci, Candida sp., gram-negative bacilli and polymicrobial organisms (5,6).

Among the risk factors for the development of BE are: age (over 60 years), male gender, use of injection drugs or dental procedures, presence of prosthetic valve or intracardiac device, history of valve disease (rheumatic heart disease, prolapse of the mitral valve, aortic valve disease, mitral regurgitation), congenital heart disease (aortic stenosis, bicuspid aortic valve, pulmonary stenosis, ventricular septal defect, patent ductus arteriosus, coarctation of the aorta and tetralogy of Fallot), intravenous catheter, immunosuppression, hemodialysis patients (6,7).

Although dental procedures are considered risk factors for the development of BE, the spread of bacteria present in the oral cavity into the bloodstream can also happen daily, through routine oral care (flossing and brushing) and physiological processes such as mastication (6). The bacteremia that occurs in everyday events is commonly called transient bacteremia, and the prevalence is close to 20-68%, higher than in invasive or non-invasive dental procedures (7-50%;), reinforcing the importance of daily oral care (7,8).

Furthermore, studies have shown that most patients with BE had dental problems, poor oral hygiene and did not attend regular dental appointments (8). In this sense, given the relevance of the subject in Dentistry, it is essential to explore pathogenic microorganisms and the mechanism of induction of the chronic systemic inflammatory response in susceptible individuals, which culminates in the development of EB.

LITERATURE REVIEW

The review followed the precepts of the exploratory study, through a bibliographical research in books and scientific articles on the subject. The search was done in the PubMed, EMBASE and Virtual Health Library (BVS) platforms, which includes the following databases: LILACS, Scientific Electronic Library Online (SCIELO) and Regional Library of Medicine (BIREME), in addition to a complementary search in Google Scholar and article references. The MeSH and DeCS descriptors used included the combination of terms "endocarditis", "bacteremia" and "oral hygiene" and their derivatives, using Boolean operators ("AND","OR").

Searches were carried out between June and August 2020 by a single examiner. The inclusion criteria for papers were articles that related bacterial endocarditis to dentistry, with no restriction on design. Studies that did not relate bacterial endocarditis to oral hygiene/dentistry, unavailable online, or to a population with an orthodontic appliance were not considered eligible.

Studies were first selected through titles and abstracts, and articles that did not meet the inclusion criteria were excluded. The second step was the removal of duplicates and critical reading of the texts in their entirety, excluding those articles that escaped the topic (study of antibiotic treatment or prophylaxis for endocarditis, for example), those not related to dentistry or not available online.

For data collection, an exploratory reading of all the selected material was conducted, registering the information extracted from the sources. The interpretation of the results was done through an analytical reading, in order to organize the presentation of the findings. Our

search returned 372 articles. After analyzing titles, abstracts and excluding duplicates, nine articles were included in the review and analyzed in full. Figure 1 shows the flowchart that summarizes the study selection process and Table 1 shows the details on the selected studies.

DISCUSSION

Despite technological advances in diagnostic procedures and scientific research, BE remains a disease with poor prognosis and high mortality (9). For these reasons, as well as recent changes in the epidemiology of Endocarditis and the discovery that oral bacteria have a high influence on this disease, a new look must now be considered (10).

It is evident that the oral cavity provides adequate conditions for the development of 700 microorganism species, such as commensal bacteria, which are necessary for body homeostasis (8). However, bacteria present in the mouth have the ability to adhere to non-

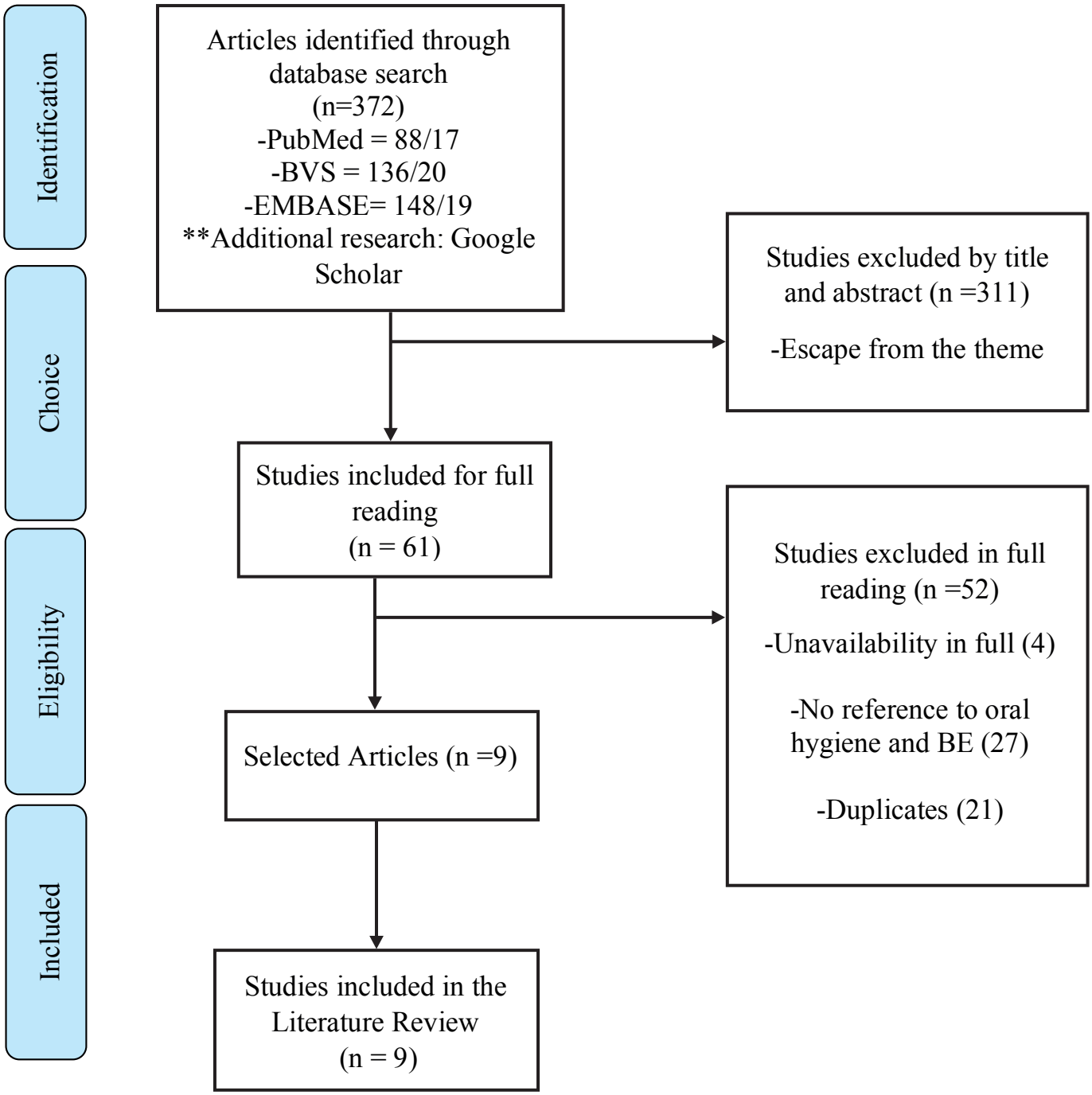

Figure 1 - Flowchart of studies assigned in the literature review.

Table I - Detailed analysis of the studies included in the literature review.

TITLE:	AUTHOR/YEAR:	BRIEF CONSIDERATIONS:
Dentists Are Innocent! "Everyday" Bacteremia Is the Real Culprit: A Review and Assessment of the Evidence That Dental Surgical Procedures Are the Main Cause of Bacterial Endocarditis in Children	Robert G. J., 1999	The review aimed to analyze the relationship between bleeding and odontogenic bacteremia, intensity and cumulative exposure. Bacteremia is significantly higher in daily dental procedures compared to operative procedures. The use of antibiotic prophylaxis before dental treatment in patients without comorbidities is questioned
Is there a link between tooth brushing and infective endocarditis?	Martin M., 2003	We lack the necessary scientific knowledge and evidence to conclude that transient bacteremia caused by routine activities is responsible for most cases of BE, or that good oral health would prevent or reduce the risk of endocarditis.
Bacteremia associated with tooth brushing and dental extraction	Lockhard P. B. et al., 2008	Although amoxicillin has a significant impact on bacteremia in tooth extractions, oral hygiene and toothbrushing may pose a greater threat to individuals at risk of developing infective endocarditis
Bacteremia originating in the oral cavity. A review	Roda P. et al., 2008	Critical review of dental procedures and bacteremia. Advances in our knowledge of the etiopathogenesis of bacterial endocarditis have placed less and less importance on invasive dental treatment as a causal factor - with increasing importance being attributed to factors associated with oral hygiene and health
Bacteraemia due to dental flossing	Crasta K. et al., 2009	Flossing can produce bacteremia in periodontal healthy patients and individuals with periodontal disease at a rate comparable to that caused by some dental treatments for which antibiotic prophylaxis is administered to prevent BE.
Poor oral hygiene as a risk factor for Infective endocarditis–related Bacteremia	Lockhart P. B. et al., 2009	Daily oral hygiene practices reduce the colonization rates of pathogenic bacteria that have the potential to cause damage to the host (by direct or indirect effect).
Incidence and magnitude of bacteraemia caused by flossing and by scaling and root planing	Zhang W. et al., 2013	No differences were found between flossing and scaling and root planning in the incidence or magnitude of total bacteremia or *Streptococcus viridans*. This finding is important in the ongoing re-evaluation of antibiotic prophylaxis to prevent infective endocarditis.
Health Care-Associated Infective Endocarditis: a Growing Entity that Can Be Prevented	Benito N. et al., 2014	Measures to prevent infection of valve prostheses and implantable cardiac devices at the time of implantation are also important, as well as oral hygiene in patients with cardiac devices.
Associations between bacteremia from oral sources and distant-site infections: tooth brushing versus single tooth extraction	Mougeout F. B. et al, 2015	Although antibiotic prophylaxis has significantly decreased the incidence of bacteremia, the similarity between the incidence of bacteremia after brushing and extraction undermines antibiotic prophylaxis as an effective strategy for preventing these sites far from infections.

scaly surfaces, such as teeth, and to organize themselves into dental biofilms (4).

Despite the harmonious environment under normal conditions, when there is an increase in the consumption of fermentable carbohydrates by the individual, the proliferation of acidogenic and aciduric bacteria (e.g., *Streptococcus mutans*) is favored in the accumulated biofilm on the tooth surface (4). The formation of a biofilm acts as a form of protection for oral microorganisms and allows the growth and aggregation of more virulent species, making the biofilm harmful. If left untreated, dental plaque can invade subgingival sites, altering the microbiota and increasing the likelihood of invasion of the bloodstream and fixation in other sites (5).

From the moment bacteria, mainly periodontal, reach the bloodstream, they release pro-inflammatory substances and raise the levels of C-reactive protein, aiming at the permanence and reach of other tissues, such as the heart, increasing the risk of cardiovascular disease (5). After colonization, there is a maturation process, in which microorganisms take advantage of the coagulating mechanisms, such as fibrinogen and fibrin, to resist destruction (11).

The next step is the destruction of the host's cells. This happens through multiple virulence mechanisms with the release of inflammatory mediators, such as toxins and enzymes, alpha-hemolysin and modulins, which attach to heart valves (collagen surface) and biofilms, forming an ecological niche that favors bacterial expansion and contributing to cell death (12,13).

Oral bacteria reach the bloodstream through invasive dental procedures such as tooth extractions that cause so-called transient bacteremias and are responsible for about 10% of BE, according to Mang-de la Rosa et al. (2014) (13). Another way is through oral hygiene and daily activities. Several studies published since 1954 have already reported the presence of bacteremia resulting from toothbrushing. However, these works should be viewed with caution as there were inherent limitations at the time, such as the absence of molecular technology.

The entry point for *Streptococcus viridans* bacteria, responsible for 50% of cases of BE, into the bloodstream in daily activities happens through the surface of the crevicular gingival tissue around the teeth during tooth brushing (14). Bacteremia resulting from toothbrushing is estimated to occur more than two hundred times a year (14-20).

Lockhard et al. (2008) did a double-blind randomized clinical trial that analyzed the cumulative bacterial incidence in the blood for a group that underwent tooth brushing, another group used amoxicillin after unit extraction (according to the recommendations of the American Heart Association, AHA) and a third, which performed extraction with placebo medication similar to amoxicillin. There was a statistically significant difference, showing that amoxicillin has an impact on bacteremia from a single tooth extraction. Toothbrushing has broken a much larger surface area of tissue from the gingival crevices and has a bacterial incidence from the common daily oral hygiene activity (14).

Furthermore, in another result of the same study, the presence of generalized bleeding after toothbrushing was associated with an almost eight-fold increase in the risk of developing bacteremia (14). The authors found that rates of oral hygiene and gingival disease were significantly associated with IE-related bacteremia after toothbrushing. Participants with medium plaque and calculus had a 3.78 and 4.43 times greater risk of developing bacteremia, respectively. The presence of generalized bleeding after brushing was associated with an almost eight-fold increase in the risk of developing bacteremia (15).

Other studies have found that activities of daily living such as eating, chewing gum or using toothpicks can also induce detectable bacteremia in a variable percentage of subjects (18). According to Mougeot et al. (2015) and Poveda-Roda et al. (2008), the intensity of bacteremia produced by invasive dental treatment such as tooth extraction is similar to that induced by activities of daily living (18,20).

The risk of bacteremia after flossing is unclear as there is little published evidence available. A critical evaluation of these studies revealed that they had methodological deficiencies, such as the lack of a periodontal diagnosis. In the study by Castra et al. (2009) through a clinical trial found that the incidence of bacteremia is comparable to the rate that occurs in periodontal treatment procedures, such as probing, ultrasonic scaling, subgingival irrigation and sizing and prophylaxis (12,19). In 2015, Zhang et al., in a cross-sectional

study that evaluated the incidence and magnitude and bacterial diversity of bacteremia due to flossing compared to root scaling found no difference between groups (12).

The authors found that rates of oral hygiene and gingival disease were significantly associated with IE-related bacteremia after toothbrushing. However, we lack the scientific knowledge needed to firmly conclude that transient bacteremia caused by routine activities is responsible for most cases of BE, or that good oral health would reduce the risk of endocarditis. Most authors point to the need for multicenter randomized clinical trials to examine this hypothesis further (12,18).

CONCLUSION

This review presents a synthesis of the literature that analyzes the role of oral hygiene in the development of bacterial endocarditis. According to the articles analyzed, the lack of oral hygiene in individuals with cardiovascular disorders can cause bacteremia and be a predisposing factor for BE. It highlights the need for dentists to know the development mechanism so that they can act more safely, understanding the importance of Dentistry in this process for the patient. Further studies are needed in order to improve the understanding of the influence of oral pathogens on the development of endocarditis in susceptible patients.

The authors declare no conflicts of interest.

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