In this article, we review the evidence regarding the risk of endocarditis in dentistry and the measures that can be taken to prevent it. Evidence acquisition: Studies have shown that invasive dental procedures, such as tooth extractions and periodontal surgery, can cause bacteria to enter the bloodstream, leading to infective endocarditis. Specific individuals are at higher risk of developing endocarditis, including those with pre-existing heart conditions, prosthetic heart valves, and a history of endocarditis. Evidence Synthesis: To minimize the risk of endocarditis in dental patients, the American Heart Association (AHA) has issued guidelines for using antibiotics.
Introduction

Infective endocarditis remains a significant problem of general pathology and medical and surgical cardiology.\textsuperscript{1-3} Endocarditis is a rare but potentially life-threatening infection of the heart’s inner lining, known as the endocardium. It can occur in individuals with underlying heart conditions or those who have undergone invasive medical or dental procedures. Dental procedures are among the most common causes of infective endocarditis (IE), accounting for up to 10\% of all cases. Antibiotic prophylaxis in patients undergoing dental procedures (oral surgery, orthognathic surgery, invasive intervention Campo 4) has been a debate among healthcare professionals. The current guidelines recommend antibiotic prophylaxis only for patients at high risk of IE, while others argue that this approach may not be sufficient to prevent the condition. The effectiveness of other preventive measures, such as improved oral hygiene and patient education, has also been questioned. Therefore, there is a need for a comprehensive review of the literature on the risk of endocarditis associated with dental procedures and the measures that can be taken to prevent this condition.\textsuperscript{4-6}

Despite significant advances such as the discovery of antibiotics, the progress of cardiac surgery (which allows the hemodynamic consequences of valvular lesions to be corrected) and the possibility of effective antibacterial prevention, the global frequency of the disease and its mortality have not decreased. The decrease in the forms of subacute or slow endocarditis (Osler’s disease) usually caused by streptococcus is more than compensated for by the increase in the number of acute conditions due to very virulent germs coming from different and new sources: resuscitation, hemodialysis, heroin addiction, recalling, finally, the forms of endocarditis at the level of valve prostheses, whose seriousness is well known.\textsuperscript{7,8}

The disease diagnosis is often relatively late, which dramatically aggravates the prognosis.\textsuperscript{9-11}

The subacute forms often manifest themselves in a moderate condition and are even trivial for a long time, sometimes indistinguishable from the underlying valvular disease. The majority of the acute forms are primitive, and for this reason, attention is not primarily drawn to the heart. The diagnostic difficulties are even more significant for endocarditis implanted at the valve prostheses level. Blood culture naturally remains the decisive diagnostic tool.\textsuperscript{12-15}

The nosological entity known as infective endocarditis includes numerous syndromes: infective, local (with the evolution towards the valve lesion), embolic and immunological, the juxtaposition of which takes into account the protean clinical aspects and explains the frequency of diagnostic delays (2 - 3 months, on average, in subacute forms).\textsuperscript{16-18}

This article aimed to provide an overview of the current knowledge on the risk of endocarditis associated with dental procedures and the preventive measures that can be taken in dental patients to reduce this risk. The review will focus on the evidence supporting antibiotic prophylaxis and other preventive measures, such as improved oral hygiene, patient education, and the use of dental devices. The results of this review will be valuable for healthcare professionals involved in dental care, policymakers developing guidelines for the prevention of endocarditis in dental patients, and patients who may be at risk of developing this serious condition. This manuscript aimed to provide an overview of the existing literature on the risk of endocarditis associated with dental procedures and the measures that can be taken to prevent this condition.

Keywords: Biological Incident; Endocarditis; Oral Health; Oral Surgery; Prophylaxis.
Materials and methods

Search Strategy
A comprehensive literature search will be conducted using electronic databases, including PubMed, Embase, and Cochrane Library. The search will be limited to studies published in English from January 2003 to Jan 2023. The following search terms will be used: "endocarditis," "infective endocarditis," "dental procedures," "dental care," "oral hygiene," "antibiotic prophylaxis," and "prevention."

Inclusion Criteria
Studies that investigate the risk of endocarditis associated with dental procedures, the use of antibiotic prophylaxis in dental patients, and the measures taken to prevent endocarditis in dental patients will be included. The studies can be randomized controlled trials, observational studies, or systematic reviews/meta-analyses.

Exclusion Criteria
Studies focusing on endocarditis not associated with dental procedures, studies published before 2003, studies not published in English, manuscripts on animals and studies that do not meet the inclusion criteria will be excluded.

Data Extraction
Data will be extracted from the selected studies, including study design, population characteristics, intervention, outcome measures, and main findings. The data will be organized using a data extraction form developed specifically for this review.

Data Analysis
The data will be analyzed using a narrative synthesis approach. The findings of the selected studies will be summarized and organized according to the research question. The results will be presented in a table format and discussed in the text.

Fi-index tool
Fi-index tool has been performed to reduce the risk of auto-citation in this manuscript.19, 20

Clinical Picture
1. Subacute endocarditis
Osler’s disease. It is due to infection with a slightly virulent germ (usually streptococcus) at a pre-existing cardiac lesion level during transient bacteremia. The most frequent entrance door is the dental one (10-20% of all endocarditis): in particular, extraction of an infected tooth without antibiotic prophylaxis in a patient with valvular heart disease (very often it is heart disease not known and endocarditis becomes the telltale episode).21,22 Much rarer are the otorhinolaryngological (streptococcus), urinary or genital (streptococcus D, plus staphylococci aureus which is also responsible for the acute forms) entrance doors. All heart diseases characterized by the presence of turbulent flows can be the site of an infection. Classically, rheumatic heart diseases are in the first place: nettle insufficiency, mitral insufficiency, more rarely, aortic stenosis and, above all, mitral stenosis. However, the reduction in the frequency of rheumatic fever has not been accompanied by the expected decrease in the forms of subacute endocarditis. The latter manifests itself in the same way also on atheromatous valve lesions and, above all, congenital heart disease: not so much the classic forms (tetralogy of Fallot, patent arterial duct, interventricular defect, aortic coarctation) in which antibacterial prophylaxis is a well consolidated, as were the lesions that are difficult to identify because they are usually silent and whose frequency and importance has been revealed using echocardiography: bicuspid aortic valve and mitral valve prolapse.23-26

2. Acute endocarditis
It is defined as an essential and rapidly evolving infectious syndrome (death within a few weeks before the advent of antibiotics). The diagnostic elements are entirely different. It is a massive septicemia whose starting point is easily found:

- catheter or cannula for intravenous infusion left in place for a long time, which is the source of septicemia from staphylococcus aureus or Gram-negative germs;
- surgical entry doors (same germs);
- heroin addiction (gold staphylococcus);
- arteriovenous shunts for hemodialysis (gold staphylococcus);
- manipulations on the urinary tract or genitals (gram-negative germs);
- pneumopathies (pneumococcus);
- otorhinolaryngological affections (streptococci
and other Gram-positive cocci).

The diagnosis of septicemia is then evident, while that of endocarditis is not so: the implantation of germs almost always takes place on a healthy endocardium (primitive endocarditis), an event made possible by many circulating germs. It is usually the finding of a murmur, otherwise rarely characteristic, which reveals the associated endocarditis.

3. Prosthetic endocarditis

It arises on valve prostheses or intracardiac patches and can occur early, within the first two postoperative months. In this case, it is due to a perioperative infection from hospital germs (golden staphylococcus and albo, Gram-negative germs) and assumes the clinical aspects of the acute forms. When, on the other hand, it manifests itself late, endocarditis does not differ from the other subacute forms either for the entrance doors, for the responsible germs or the symptoms. However, the presence of a prosthesis complicates the diagnosis (in particular as regards the contribution of echocardiography) and, above all, the treatment; it is an infection implanted on a foreign body, in fact, similar to what happens, for example, for osteomyelitis on osteosynthesis material.

Results

Diagnosis

The diagnosis of infective endocarditis is a diagnosis of affirmation. The usual delay in diagnosis is the leading cause of the persistent severity of the disease. It is, therefore, necessary to have the greatest prudence in formulating the diagnosis of rheumatic fever in children, thromboembolic illness in adults, and neoplastic fever in the elderly.

Symptoms and Tests

1. Subacute forms

- Onset is progressive: sometimes, the disease begins suddenly, with a feverish episode lasting a few days. The anamnesis sometimes allows us to detect, in the weeks, sometimes in the months that precede, more or less discontinuous feverish episodes, soon accompanied by an alteration of the general state, from arthralgias, myalgias, pallor. The frequent prescription of antibiotics during fever episodes eliminates the fever and prolongs its evolution until the moment when the diagnosis is recalled by the presence (or consideration) of a heart murmur. Hospitalizing the patient to perform blood cultures in optimal conditions is necessary. Some clinical elements can, already at this stage of the disease, make the diagnosis almost inevitable, even if the blood cultures remain negative:
  o the significant increase in the intensity of a previously known murmur (or the presence of a massive regurgitant murmur when the X-ray and electrocardiogram are normal, which confirms the recent character of the valve lesion);
  o the presence of splenomegaly (10% of cases);
  o the appearance of cutaneous signs (20-25% of cases): Osler's nodules, erythematous nodules of the fingertips, evolving for a few days' poussée, painful, which can be easily traced from the anamnesis, and whose importance semiological is absolute and purpuric manifestations, of which the purpuric streaks found in the fundus of the eye in 5% of cases (Roth's streaks or septic retinitis) whose diagnostic value is considerable;
  o finally, it highlights an entrance door of the germ, a dental abscess, or dental treatment performed without antibiotic coverage during the previous weeks or months.

- Laboratory tests are not, except for blood culture, of much help.
  o the blood count often shows anaemia, less often leukocytosis.
  o the erythrocyte sedimentation rate is variable.
  o electrophoresis shows an increase in y-globulins, less often an increase in a2-globulins.
  o the urine sediment rarely shows (in 10% of cases) very transient microscopic hematuria.
  o more interesting is the so-called "immunological syndrome", which has been much insisted on recently and is explained by the persistence in circulating bacterial antigens for a relatively long period. These
antigens condition the formation of antibodies (immunoglobulins) and the appearance of antigen-antibody immune complexes that trigger the activation of the classical complement pathway.

It is thus possible to find a fall in the total silk complement and some fractions, positivity to the Waaler-Rose reaction and the latex test, the presence of cryoglobulins, and the presence of circulating immune complexes. However, the described immunological syndrome, which is also not specific, is very inconstant (40-50% of cases) and is only observed in forms with a protracted evolution.

- The value of blood culture, therefore, remains fundamental. Blood cultures should be performed according to precise rules: from 4 to 6 blood cultures in 2 days, or 9 in 3 days, on aerobic and anaerobic soils, with samples taken preferably at fever pitches and, above all, chills. However, blood cultures are equally positive outside of feverish episodes and, occasionally, in afebrile patients. Positive blood cultures should indicate septicemia and not bacteraemia, which means at least two positive blood cultures for the same germ (otherwise, it is probably contamination) and separated by a time interval of at least 6 hours. Germs usually grow in 1-3 days, sometimes much slower. Once isolated, the germ should be studied and performed to choose the appropriate antibiotic treatment and susceptibility test. The latter should be performed frequently to determine the bactericidal power of the patient's serum on the isolated strain. The diagnostic difficulties are increased when the blood cultures, performed according to the rules, remain negative. We must then admit that we are dealing with germs with attenuated virulence; numerous bacteriological and histological studies performed on surgically removed valves have shown that, in these cases, streptococcus is almost always the cause. In these cases, treatment is required when the clinical picture is typical of endocarditis and, above all, when the characteristic signs of the disease are highlighted on the echocardiogram.29

- Echocardiography is a fundamental means of investigation in infective endocarditis. The importance of echocardiography is threefold:
  - from a diagnostic point of view, as it reveals the presence of vegetation (Figures 1, 2);
  - from an etiological point of view, in discovering an underlying heart disease;
  - from a prognostic point of view, for an evaluation for surgery.14,15,30

**Figure 1.** Aortic insufficiency due to infective endocarditis. Vegetations could be observed through echocardiographic examination

**Figure 2.** Gross pathology of subacute bacterial endocarditis involving mitral valve. The heart's left ventricle has been opened to show mitral valve fibrin vegetations due to infection with Haemophilus parainfluenzae. Autopsy. Content Provider(s): CDC/Dr. Edwin P. Ewing, Jr. Creation Date: 1972 Copyright Restrictions: None - This image is in the public domain and thus free of any copyright restrictions’

The vegetations are echocardiographically represented by dense, irregular, heterogeneous echoes, integral with the valves, which however maintain their mobility (contrary to the appearance of valvular stenosis). The smallest vegetation is detectable by echocardiography, which measures
about 2 mm. They have a perfectly linear appearance, with the characteristic "flag" morphology on the sigmoid aorta. Sometimes it is possible to observe the arctic vegetation prolapse inside the left ventricle (Figure 1) and the mitral ones inside the left atrium. At the mitral and tricuspid level, the usual appearance is that of a valvular thickening in the diameter stoles and frequently also in systole (figure 1). It is sometimes difficult to distinguish the appearance of vegetation from that of rupture of the tendon cords, although the latter is often due to endocarditis. When aortic insufficiency is associated finally, simultaneously with the thickening of the mitral valve, there should be a fluttering of its anterior leaflet in diastole (Figure 1). In some cases, the diagnosis of endocardial vegetation is made considerably more precise by two-dimensional echocardiography, above all in the fascinating cases in which very large and mobile vegetations go so far as to obstruct the mitral orifice.

Finally, in addition to the diagnosis of the underlying heart disease (very often not diagnosed until the moment of the endocardial complication), echocardiography can provide critical prognostic elements also for a possible surgical decision: for example, the detection of an early closure mitral valve is indicative of severe aortic regurgitation. It is possible with two-dimensional echocardiography to demonstrate a septal and sub-annular abscess or through an abnormal communication between two cavities (more frequently in acute forms). The prognostic interest in the echocardiographic control of the vegetation is relatively scarce: the latter can undergo calcification processes over time, and the appearance of "vegetation" can often persist even after clinical healing.30

In the presence of the typical clinical, bacteriological and echocardiographic picture, the diagnosis of endocarditis is usually easy to establish. Otherwise, the problem arises with the antibiotic treatment of endocarditis with negative blood cultures. Undoubtedly, since it is usually a streptococcal infection, the choice of antibiotic treatment is simple. However, experience shows that many of these systematic treatments are arbitrary, especially when the average ECG or cardiogram and the typical immunological changes are absent. However, let us recall Friedberg's statement: in a valvulopathy subject, any fever of an unexplained nature lasting more than eight days should be treated as endocarditis. This rule is probably excessive since endocarditis is extremely unlikely in some exceptional cases (such as fever in mitral stenosis with total arrhythmia and/or heart failure). The decision to treat (or not to treat) must then be taken in a specialized hospital environment, with the availability of an excellent bacteriological laboratory.21-33

2. Acute forms

They have become frequent with the increase in hospital environment infections (from catheters, in particular) and the diffusion of heroin addiction. The diagnostic problems seen in the subacute forms are not generally in the foreground here: the entrance door is usually evident, and the clinical picture of septicemia is beyond doubt, with symptoms of major infections, constant hyperleukocytosis, and rapidly positive blood cultures. Splenomegaly is no longer very frequent, and skin signs (as well as the immunological syndrome) do not have time to appear. Often, the clinical picture is suddenly enriched by the appearance of early complications (see below). The diagnosis of endocarditis is easily suggested when there is an important valve murmur. However, this often does not occur for various reasons: the endocarditis is usually primary; the frequent tricuspid localization gives rise to a slight systolic murmur, and listening is often normal. In the latter case, the diagnosis can then be formulated during septicaemia due to the occurrence of repeated pulmonary emboli; finally, it should be remembered that (as in damage to the left heart) there is a certain period of auscultatory latency when there are only vegetations, without valve mutilations (autopsy diagnoses are frequent in these cases). All these elements underline the enormous value of echocardiography: with this test, which in cases of subacute endocarditis is approximately 50% positive, the percentage of positivity here reaches 90% (on condition that the tests are repeated every eight days, given that the first test may be negative). The problem of acute endocarditis is essentially therapeutic: the virulence and relative resistance of the germs involved give rise to heavy mortality.34-36

3. Prosthetic endocarditis

They can be late, subacute, or early (in the first two postoperative months) of the acute type. The frequency of these forms is the same (1%), and all
prostheses can be involved. The diagnostic difficulties are variable. They are of two kinds: oechocardiography is usually of little help; only the two-dimensional examination can sometimes make it possible to identify vegetation implanted on a prosthesis; or the recognition through blood culture of early postoperative septicaemia after the application of a prosthesis corresponds only in the minority of cases to an endocardial implant but, usually, to septicemia both from catheter and associated with mediastinitis. Only direct signs of damage to the prosthesis or embolic signs allow for affirming endocarditis. However, Friedberg's rule (unexplained fever = endocarditis) must be applied categorically here and the duration of the antibiotic treatment must be fixed accordingly. Endocarditis on early prostheses has a certain bacteriological individuality, the most frequent germ involved being staphylococcus albo, followed by staphylococcus aureus and Gram-negative bacilli. As a rule, negative blood cultures are observed in streptococcal forms.37,38

4. Particular clinical forms

• Endocarditis in children is rare. It always refers to subacute endocarditis caused by streptococcus, complicating a congenital heart disease. Their prognosis is good. However, in some cases where they complicate rheumatic endocarditis, they should not be confused with a recurrence of the rheumatic disease itself.39
• Endocarditis of drug addicts is becoming very frequent. They are observed with a frequency of more than one case per thousand drug addicts per year. These are acute endocarditis, most frequently due to staphylococcus.37,40

This endocarditis is the aetiology of most tricuspid localizations. Alongside the golden staphylococcus, Gram-negative germs and fungi can sometimes be identified. The prognosis is initially favourable due to the relative sensitivity of the staphylococcus and the non-threatening nature of the induced tricuspid lesions; the embolic phenomena are generally only at the pulmonary level. However, relapses due to the continuation of drug addiction make the long-term prognosis extremely poor.

5. Fi-index tool

This manuscript has been checked with the Fi-index tool, and a score of 0.18 was obtained for the first author only on 12/03/2023 according to SCOPUS®. The fi-index tool aims to ensure the quality of the reference list and limit any auto-citations.

Complications

Resistance Streptococci are always sensitive to a well-chosen antibiotic association. sometimes very high. Regarding Staphylococcus albus and a certain number of Gram-negative bacteria, the cultures are often highly resistant. The possibility of healing with antibiotics alone is very compromised regarding prostheses. In the case of resistant germs and most endocarditis on prostheses, the antibiotic treatment must be completed by excision of the valve or the infected prosthesis. The antibiotic treatment will be followed based on the infectious syndrome's clinical evolution and laboratory data (serum bactericidal power). The persistence or reappearance of the fever must lead to new blood cultures: only their positivity testifies to the failure of the antibiotic treatment, with the implicit need for a new association or surgery. Finally, it must be remembered that the inflammatory and immunological syndrome persists for a certain time after sterilization of the lesion.41,42

1. Cardiac complications

They are the most frequent (30-40% of cases) and almost always require surgical correction.

• Heart failure can occur at any time in the evolution of the disease and often earlier in acute endocarditis. In the latter case, it is made particularly serious by a sudden, mutilating valve lesion since the heart does not have the time to adapt to the new hemodynamic situation. When heart failure is early (it can also be the revealing symptom of endocarditis), it requires emergency surgery, even before sterilization of the lesion. The speed of evolution depends on the valve in question.
• Aortic insufficiency, for example, is, at the same time, the most frequent and the most rapidly evolving. It can be diagnosed by the signs of major aortic regurgitation (sometimes with
atypical auscultation, but with evident peripheral signs) and can result in pulmonary oedema, often anginal pain, anuria, conduction disturbances from an associated septal abscess, and premature closure of the mitral valve on echocardiogram. Mitral regurgitation, more typical from a clinical point of view, evolves less rapidly. Under medical treatment, one can usually wait until the end of the antibiotic treatment to consider surgery.

- It is to be distinguished from mitral stenosis due to occlusion of the orifice by vegetations; it has a very serious prognosis, and the diagnosis is based on echocardiography.
- As for tricuspid insufficiency, its haemodynamic tolerance remains perfect over the course of months.
- Finally, we must remember the existence, frequent in acute forms, of lesions with multiple orifices, associated myocardial damage (from abscesses or of coronary origin), and conduction disturbances, which greatly increase the risks of surgery.
- In prosthetic endocarditis, the complications may consist of disconnection or thrombosis, which is very difficult to recognize.43

2. Arterial complications

There are three types.

- Embolisms are frequent (20-40%); half are represented by cerebral embolisms, with a serious prognosis preventing associated cardiac surgery.
- Arterial aneurysms of immunological origin can remain silent until they rupture. Finally, staphylococcal endocarditis is characterized by the high frequency of massive cerebral haemorrhages. Renal failure is a rare late complication that does not, with exceptions, destroy the renal parenchyma. Sometimes, revealing the disease allows the diagnosis through the kidney biopsy needle. Anuria occasionally observed in severe aortic damage, is essential for the hemodynamic origin and regresses after valve replacement.44

**Antibiotic Treatment**

It must be bactericidal, applied in large doses, continued and prolonged. Antibiotics penetrate at the level of the vegetation, but the slow development of germs requires a long time for sterilization. As a rule, combinations of synergistic antibiotics are used, the bactericidal effect of which is safer. The duration of the treatment is discussed and varies according to the resistance of the germs, generally, from 4 to 6 weeks. The treatments carried out by the venous route (employing penicillins) are the most effective (Table 1).45

**Table 1. Antibiotic treatments**

<table>
<thead>
<tr>
<th>Streptococcal and staphylococcal D (enterococcus) endocarditis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin is the primary treatment: 30 to 50 million units per day. It should be remembered that 1 million penicillin sodium contains 47 mg (1.7mEq) of sodium. The administration of many tens of millions of units of this antibiotic can lead to an excessive daily supplement of sodium, especially if they are already there are signs of decompensation; in these cases, it is, therefore, advisable to resort to potassium penicillin, even if this salt is tolerated a little less well.</td>
</tr>
<tr>
<td>Penicillin will be combined, on the basis of the antibiogram, with an aminoglycoside: either streptomycin (1 g/day) or gentamicin (1 mg/kg x 3 days). When the germ is sensitive, the American authors propose limiting the association with aminoglycosides to the first 15 days. The total duration of treatment can then often be reduced to 1 month.</td>
</tr>
<tr>
<td>In case of allergy to penicillin, instead of the classic combination of tetracycline + erythromycin per os, vancomycin by the intravenous route is currently preferred.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Staphylococcal endocarditis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strains sensitive to methicillin are treated with a methicillin + aminoglycoside combination; methicillin-resistant strains with vancomycin alone or combined with aminoglycosides. The treatment will last 45 days.</td>
</tr>
</tbody>
</table>
3. **Side therapies**

No corticoids should be associated with antibiotics (except in exceptional cases of a severe allergy to antibiotics), or anticoagulants, given the very clear aggravation of the neurological complications that these involve, and which are observed in particular in endocarditis on prostheses, where however, anticoagulant treatment remains mandatory. In case of heart failure in the preoperative period, treatment with digitalis and diuretics, and especially with vasodilators, is used.46

**Surgical Treatment**

The indication for a valve replacement with a prosthesis may be, more usually, heart failure due to severe valvular damage (haemodynamic indication), the excision of a valve focuses resistant to antibiotics (bacteriological indication), or the association of the two cases (mixed indication, frequent in staphylococcal and bacillus endocarditis Gram-negative).

- The haemodynamic indication must be given from the first signs of heart failure, without considering the duration of the antibiotic treatment. The prognosis does not change depending on whether the valve culture is positive or negative. However, in aortic damage (usual indications) the frequency of prosthesis disconnection is higher when the lesions are not yet sterilized, which often exposes them to a re-operation. In these cases, it is often necessary to carry out complex surgical monitoring, going as far as inserting the prosthesis in the ascending aorta with coronary bypass implantation in the downstream section.

  When the culture of the excised valve is positive, treatment will be indicated during the 45 days following the operation. If the cultures are negative, the antibiotic treatment will be much shorter.

- The bacteriological and mixed indications make it possible to heal a certain number of patients. However, when the germ is very resistant, the infectious recurrence on the prosthesis is not uncommon. In the case of infected tricusps, it has been demonstrated that exeresis of the valve without replacement (since this last operation can be performed 6 to 12 months later) is possible and greatly reduces the number of infectious recurrences.

- For infected prostheses, the surgical indication is frequent and, in principle, systematic when dealing with staphylococci, germs Gram-negative and fungi. The results are better when the operation is deferred and the patient is operated on under effective antibiotic treatment.47,48

**Prophylaxis**

Its importance is fundamental in every heart patient exposed to bacteraemia. In a previous issue of this journal, the indications and methods of this prophylaxis were reported, according to what the American Heart Association recommended in 1977. At the end of 1982, the British Society for Antimicrobial Chemotherapy49 issued prophylaxis standards including much more limited indications and much simpler methods, especially considering the very low practical observance (15%) found for the previous standards. We report here the most recent recommendations of the British company (Table 2, 3).45,50-55

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**Bacillus endocarditis Gram negatives**

They are very difficult to sterilize and the most effective combination must be carefully studied in the laboratory. It will associate carbenicillin (or, more often, with a 3rd generation cephalosporin) gentamicin, tobramycin or amikacin. But often surgery is also necessary during antibiotic treatment.

**Fungal endocarditis**

These are treated with the combination amphotericin B + 5 fluorocytosine. Culture negative endocarditis.

They are treated as potentially resistant streptococcal endocarditis, i.e., with the combination of penicillin + gentamicin for 45 days.
A single administration of 3g of amoxicillin orally 1 hour before surgery is sufficient.

In general anaesthesia: amoxicillin 1g IM before induction and 500mg orally after 6 hours.

In patients at particularly high risk: amoxicillin 1g IM combined with gentamicin (Gentalyn f 80 mg), administered 15 min before surgery (or immediately before induction if this is performed under general anesthesia), followed by amoxicillin 500 mg orally after 6 hours.

In patients allergic to penicillin or who, having already been treated with penicillin, may harbour germs resistant to it, this drug should be replaced with erythromycin stearate 1.5g per os 1-2 hours before surgery and 500mg 6 hours after; or, in particularly high-risk cases: vancomycin g intravenously over 20-30min followed by gentamicin 120mg intravenously.

**Table 2. For manoeuvres of the oral cavity and the other respiratory tracts**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antimicrobial Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth extractions</td>
<td>A single administration of 3g of amoxicillin</td>
</tr>
<tr>
<td>Ablation of tartar</td>
<td>orally 1 hour before surgery</td>
</tr>
<tr>
<td>Surgical periodontal procedures</td>
<td>Amoxicillin 1g IM before induction and 500mg</td>
</tr>
<tr>
<td>Operations involving bone</td>
<td>orally after 6 hours</td>
</tr>
<tr>
<td>Implantology</td>
<td>Amoxicillin 1g IM combined with gentamicin</td>
</tr>
<tr>
<td></td>
<td>(Gentalyn f 80 mg), administered 15 min before</td>
</tr>
<tr>
<td></td>
<td>surgery and 500mg orally after 6 hours</td>
</tr>
</tbody>
</table>

**Table 3. For manoeuvres under general anaesthesia on the genitourinary or gastrointestinal tract**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antimicrobial Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>The administration of amoxicillin 1g IM,</td>
<td>associated with gentamicin 120 mg IM,</td>
</tr>
<tr>
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<td>administered immediately before induction,</td>
</tr>
<tr>
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<td>followed by amoxicillin 500 mg orally after</td>
</tr>
<tr>
<td>followed by amoxicillin 500 mg orally after</td>
<td>6 hours is prescribed</td>
</tr>
<tr>
<td>6 hours is prescribed</td>
<td>In patients allergic to penicillin: vancomycin</td>
</tr>
<tr>
<td>In patients allergic to penicillin: vancomycin</td>
<td>1g IV over 20-30 min followed by gentamicin 12</td>
</tr>
<tr>
<td>1g IV over 20-30 min followed by gentamicin</td>
<td>g IV just before induction.</td>
</tr>
<tr>
<td>120 mg IV just before induction.</td>
<td></td>
</tr>
</tbody>
</table>

**High-risk categories in dentistry**

In the following conditions, prophylaxis is essential (for patients in medium and high-risk categories) (Table 4) (Figure 3):

**Table 1. Endocarditis high-risk intervention in dentistry**

<table>
<thead>
<tr>
<th>Intervention</th>
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<td></td>
<td>surgery and 500mg orally after 6 hours</td>
</tr>
</tbody>
</table>

**Figure 3. Schematization of treatments**

First, it will be good to provide for reducing inflammation and the infectious process through local measures in the intervention site (improvement of oral hygiene, rinsing and sulcular irrigation with chlorhexidine) to reduce the extent of bacteremia. It will then be essential to implement a prophylaxis protocol in all those situations, as indicated by the guidelines and mentioned above.

**Discussion**

Endocarditis is a serious condition resulting from bacterial infections, and dental procedures have been identified as a potential risk factor for developing this condition. The current discussion will focus on the evidence regarding the risk of endocarditis in dentistry, the guidelines for antibiotic prophylaxis, and the measures that can be taken to prevent this condition. Several studies have shown that invasive dental procedures, such as tooth extractions and periodontal surgery, can increase the risk of bacterial entry into the bloodstream and the subsequent development of infective endocarditis. The risk is higher in individuals with pre-existing heart conditions, prosthetic heart valves, and a history of endocarditis. It is also important to note that certain
oral bacteria, such as Streptococcus mutants and Streptococcus sanguis, are associated with the development of endocarditis. To address this concern, the American Heart Association (AHA) has issued guidelines for antibiotic prophylaxis before invasive dental procedures. The guidelines recommend antibiotic prophylaxis for patients at high risk of endocarditis, including those with a history of endocarditis, prosthetic heart valves, and congenital heart disease with residual defects. Low-risk patients do not require antibiotic prophylaxis. It is important to note that these guidelines are regularly updated, and clinicians should stay current with the latest recommendations. In addition to antibiotic prophylaxis, good oral hygiene practices, regular dental check-ups, and early treatment of any dental infections are essential in reducing the risk of endocarditis in dental patients. Dentists should also be aware of the signs and symptoms of endocarditis, such as fever, chills, and fatigue, and refer patients for prompt medical attention if necessary. Dental therapies often lead to bleeding, causing transient bacteremia quantitatively proportional to the local trauma and local inflammation; some bacteria (streptococcus viridans, staphylococcus aureus) can colonize the platelet vegetations on pre-existing valve lesions. Approximately 20% of subacute endocarditis seems to be associated with dental treatments, and in most cases, the pathology appears within two weeks of dental surgery. Despite the guidelines and preventive measures, dental professionals still need more consensus regarding antibiotic prophylaxis in high-risk patients. Some argue that the potential risks associated with antibiotic prophylaxis, such as allergic reactions and the development of antibiotic resistance, outweigh the benefits. However, the current evidence supports antibiotic prophylaxis in high-risk patients, as it has been shown to reduce the incidence of endocarditis.

Conclusion

In conclusion, the risk of endocarditis in dentistry is a significant concern for certain high-risk patients. The prevention of endocarditis can be achieved through antibiotic prophylaxis, good oral hygiene practices, regular dental check-ups, and early treatment of any dental infections. Dental professionals should know the guidelines and stay updated with the latest recommendations to ensure the best possible care for their patients. Further research is needed to understand the risk of endocarditis in dental patients and to develop more effective preventive strategies.

Declarations

Conflicts of interest and financial disclosures

The author declares that he has no conflict percent and there was no external source of funding for the research in question.

Ethical approval

The study was approved by the University ethics committee and was conducted in accordance with the Declaration of the World Medical Association.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Infectious Endocarditis in Dentistry: A summary review on Risks and Therapies.

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Введение: Эндокардит — это тяжелая инфекция внутренней оболочки сердца, вызываемая несколькими типами бактерий, в том числе обитающими во рту. Стоматологические процедуры связаны с более высоким риском развития эндокардита у взрослых людей.


В этой статье мы рассмотрим данные о риске эндокардита в стоматологии и мерах, которые можно предпринять для его предотвращения. Сбор доказательств: исследования показали, что инвазивные стоматологические процедуры, такие как удаление зубов и пародонтальная хирургия, могут вызвать попадание бактерий в кровоток, что приводит к инфекционному эндокардиту. Определенные люди подвергаются более высокому риску развития эндокардита, в том числе с ранее существовавшими заболеваниями сердца, протезами сердечных клапанов и эндокардитом в анамнезе. Обобщение фактических
данных: Чтобы свести к минимуму риск эндокардита у стоматологических пациентов, Американская кардиологическая ассоциация (АНА) выпустила рекомендации по использованию антибиотиков для профилактики перед инвазивными стоматологическими процедурами, которые используются во всем мире. Эти рекомендации рекомендуют антибиотикопрофилактику пациентам с высоким риском эндокардита, тогда как пациентам с низким риском антибиотикопрофилактика не требуется. Другие меры, которые могут помочь снизить риск эндокардита у стоматологических пациентов, включают соблюдение правил гигиены полости рта, регулярные осмотры у стоматолога и раннее лечение любых стоматологических инфекций.

Заключение: Крайне важно распознавать признаки и симптомы эндокардита и направлять пациентов из группы высокого риска за неотложной медицинской помощью, поскольку риск развития этого состояния в стоматологии значителен. Стоматологи и медицинские работники должны знать о факторах риска и принимать соответствующие меры для минимизации риска заражения, включая антибиотикопрофилактику и соблюдение правил гигиены полости рта. Необходимы дальнейшие исследования, чтобы понять риск эндокардита у стоматологических пациентов и разработать эффективные профилактические стратегии.