Antibiotic prophylaxis in pediatric odontology. An update

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Received: 22-12-2005
Accepted: 26-03-2006

Planells-del Pozo P, Barra-Soto MJ, Santa Eulalia-Troisfontaines E. Antibiotic prophylaxis in pediatric odontology. An update. Med Oral Patol Oral Cir Bucal 2006;11:E352-7.

Indexed in:
-Index Medicus / MEDLINE / PubMed
-EMBASE, Excerpta Medica
-Indice Médico Español
-IBECS

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ABSTRACT

Most orofacial infections are of odontogenic origin, and are of a self-limiting nature, characterized by spontaneous drainage. The causal bacteria are generally saprophytes. On the other hand, invasive dental interventions give rise to transient bacteremia.

When an oral lesion is contaminated by extrinsic bacteria, the required antibiotic treatment should be provided as soon as possible. In the case of pulpitis, such treatment is usually not indicated if the infection only reaches the pulp tissue or the immediately adjacent tissues. In the event of dental avulsion, local antibiotic application is advised, in addition to the provision of systemic antibiotics.

The dental professional must know the severity of the infection and the general condition of the child in order to decide referral to a medical center.

Prophylaxis is required in all immunocompromised patients, as well as in individuals with cardiac problems associated with endocarditis, vascular catheters or prostheses.

Penicillin V associated to clavulanic acid and administered via the oral route is known to be effective against odontogenic infections. In the case of allergies to penicillin, an alternative drug is clindamycin. Most acute infections are resolved within 3-7 days.

In recent years, the tendency is to reduce general antibiotic use for preventive or therapeutic purposes.

Key words: *Antibiotics, antibiotherapy, pediatric odontology, pediatric patient, infection, antibiotic prophylaxis.*

RESUMEN

La mayoría de las infecciones orofaciales tienen un origen odontogénico, son autolimitantes y drenan espontáneamente. Las bacterias que causan estas infecciones son generalmente saprofitas. Además los procedimientos odontológicos invasivos dan lugar a una bacteriemia transitoria.

Cuando una lesión oral se contamina por una bacteria extrínseca deben administrarse la pauta antibiótica indicada, tan pronto como sea posible. En caso de pulpitis no suele estar indicado si la infección alcanza sólo al tejido pulpar o los tejidos inmediatamente adyacentes. En caso de dientes avulsionados, se aplicará antibiótico local junto con la administración de antibióticos sistémicos.

El profesional debe conocer la severidad de la infección y el estado general del niño para considerar derivarlo al centro médico.

En los pacientes cuyo sistema inmune está comprometido debe realizarse profilaxis siempre. Así como en los pacientes

con problemas cardiacos asociados con endocarditis o catéteres vasculares o dispositivos protésicos.
Los antibióticos administrados oralmente, efectivos ante infecciones odontogénicas es la Penicilina V asociada al ácido clavulánico. En caso de alergias, una alternativa, es la clindamicina. La mayoría de las infecciones agudas se resuelven en 3-7 días.
En los últimos años, se tiende a reducir el uso general de antibióticos con propósitos preventivos o terapéuticos.

Palabras clave: *Antibióticos, antibioterapia, odontopediatría, paciente infantil, infección, profilaxis antibiótica.*

INTRODUCTION

A series of differential characteristics should be explained in relation to antibiotic treatment in children:
- Young children tend to lack medical antecedents suggesting the possibility of drug allergies or adverse reactions.
- The greater proportion of water in the tissues of children, and their increased bone sponginess, facilitate faster diffusion of infection. On the other hand, such patients require adequate dose adjustment of the prescribed medication.
- The deficient oral hygiene found in most children, and the consumption of sugar-rich foods, contribute to increase the presence of germs in the mouth – thereby increasing the risk of bacteremia following oral treatments.
- In pediatric and in ear, nose and throat clinical practice, children from a very early age are known to develop infections that affect Waldeyer's lymphatic ring. Consequent prolonged antibiotic treatment – sometimes unwarranted or due to self medication - is an etiological factor underlying numerous situations of bacterial resistance to the antibiotics used in children in Spain, with clear differentiation from the situation found in adults. This must be taken into consideration before prescribing antibiotics in children. In case of doubt, the dental professional should consult the pediatrician or specialist habitually in charge of the care of the child.

ETIOPATHOGENESIS

- *Etiology of odontogenic infections in children*

Most orofacial infections are of odontogenic origin, and are of a self-limiting nature, characterized by spontaneous drainage. Treatment is based on two principles: elimination of the underlying cause, and local drainage and debridement. If a local infection is left untreated, infectious spread towards upper or lower regions of the face may occur (1).
Invasive dental procedures give rise to transient bacteremia. Only a limited number of bacterial species are implicated in the resulting infections. Antibiotics, where indicated, should be administered shortly before carrying out the dental procedure. When such procedures include infected tissues, an additional dose is indicated (2).
Several studies have evaluated the prevalence and extent of bacteremia following different dental procedures in children. In this sense, it has been shown that tooth brushing is associated with bacteremia in over one-third of children (3), and the fitting and removal of wedges / splints and braces or bands may give rise to bacteremia in a significant percentage of pediatric cases (4).
The level of oral hygiene exerts a considerable influence upon the levels of bacteremia. For this reason, optimum oral hygiene could be the most important factor for preventing complications as a result of bacteremia – even more than any antibiotic treatment regimen, according to some authors (5).
Simple dental extractions are associated with bacteremia in 40-50% of cases (3). The highest bacteremia levels are recorded after intraligamentous injections in procedures carried out under local anesthesia (96.6% of children) (6).
Tooth trauma is a risk factor for oral infection, particularly in the presence of direct pulp exposure and/or alteration of the periodontal space. The possibilities of infection increase when trauma to the hard dental or supporting tissues is in turn associated to open skin or mucosal membrane wounds.

- *Microbiology of odontogenic infections*

The bacteria that cause odontogenic infections are generally saprophytes. The microbiology in this sense is varied, and multiple microorganisms with different characteristics can be involved (7,8). Anaerobes and aerobes are usually present. In this sense, numerous aerobic species cause odontogenic infections – the most common being streptococci (9).
In the course of dental caries, the bacteria that penetrate the dentinal tubules are mainly facultative anaerobes (i.e., streptococci, staphylococci and lactobacilli). When the pulp tissue suffers necrosis, the bacteria advance through the pulp canal, and the process evolves towards periapical inflammation – with a predominance of Prevotella, Porphyromonas, Fusobacterium and Peptostreptococci (10,11).
Since dental caries was first identified as an infectious phenomenon, attempts have been made to eliminate caryogenic bacteria from the oral cavity. It is known that before actual dental eruption, over 50% of all infants present oral colonization by Streptococcus mutans (12). Colonization by these organisms after dental eruption depends on direct bacterial contagion – fundamentally from the mother. The risk increases in the presence of poor oral hygiene, unhealthy eating habits with a predominance of sugary foods, and the appearance of teeth erupting within the mouth Streptococcus mutans taking advantage of its capacity to adhere to hard surfaces (13). Lactobacilli in turn have less caryogenic potential than streptococci, and do not adhere to the dental surfaces.

- *Infectious complications*

Complications may arise as a result of either direct or hema-

togenous transmission. If treatment is delayed, the infection may spread through the adjacent tissues, causing cellulites, variable degrees of facial swelling and fever. The infectious process may also spread to bone or soft tissues. Local inflammation is observed, and gingival fistulas may develop in the apical region – this being particularly characteristic in the deciduous dentition (abscess formation). The lower dental arch may present a sublingual or submandibular abscess, while in the upper arch the infection may spread to the temporal space (10,14-16).

TREATMENT

- *Management considerations in odontogenic infections*

The following must be considered before deciding to administer antibiotics in pediatric odontology:

- The severity of the infection, when the child visits the dentist.
- Patient immune defense status.
- In the case of acute infection, if inflammation is moderate and the process has progressed rapidly, and in cases of diffuse cellulite with moderate to severe pain, or if the child has fever (1,7,17), the existing evidence advises antibiotic prescription as well as treatment of the damaged tooth.
- Infection in a medically compromised child.
- Infection that has progressed to extraoral facial spaces. In these situations the infection is sufficiently aggressive to have extended beyond the lips – thus indicating that the host defenses are unable to control the infection. Hospital admission is required in severe cases.
- Antibiotics are rarely recommended for the treatment of mild traumatisms, though in cases involving important soft tissue or dentoalveolar lesions, antibiotic prophylaxis against infection is advisable. Good antibiotic coverage is required in children with dental avulsion programmed for reimplantation. In this sense, since the use of systemic antibiotics, the incidence of external root reabsorptions has decreased in these cases. The vaccination calendar (antitetanus vaccination) must be considered when trauma occurs in a contaminated environment.
- Antibiotic treatment can be considered in patients with localized juvenile periodontitis or other types of early periodontitis (18).
- The presence of a minor, chronic or well localized abscess. Healthy children requiring the extraction of a single deciduous tooth with an abscess, or endodontic treatment of a permanent tooth, may be operated upon without the need for antibiotic treatment. In contrast, immunocompromised children, or patients with some cardiac problem, may require antibiotic treatment even if infection is a mere possibility.

- *Dental procedures in which antibiotic prophylaxis is indicated (tables 1 and 2)*

* Management of oral lesions (19):

When the oral cavity is contaminated by some extrinsic bacterium, antibiotic treatment should be administered as soon as possible to ensure optimum results – taking into account the most effective route of administration in each case (intravenous, intramuscular or oral).

Once such treatment has been started, its efficacy must be monitored; susceptibility testing is indicated in the event the patient fails to respond to the initially prescribed drug.

* Management of pulpitis, apical periodontitis, localized intraoral inflammation (20):

The bacteria may reach the pulp canal through caries lesion, via direct pulp tissue exposure after trauma, or via iatrogenic mechanisms. Penetration takes place through the dentinal tubules, dentinal cracks, or defective dental restorations. If a child presents evidence of acute pulpitis, the required dental management should be provided (pulpotomy, pulpectomy or extraction). Antibiotic treatment is usually not indicated if the infectious process only reaches the pulp or the immediately adjacent tissues, in the absence of signs of systemic infection (i.e., fever or facial swelling).

* Management of acute inflammation of dental origin (21):

A child with facial swelling secondary to dental infection required immediate dental attention. Depending on the clinical findings, management will consist of treatment or extraction of the tooth, with antibiotic coverage. Alternatively, antibiotics may be prescribed for several days to avoid spread of the infection, following by due treatment of the causal tooth.

The dental professional must know the severity of the infection and the general condition of the child in order to decide referral to a medical center for the administration of antibiotics via the intravenous route.

* Management of dental traumatisms (22):

The local application of antibiotic to the root surface of an avulsed tooth (doxycycline 1 mg/20 ml) reduces root reabsorption and increases pulp vascularization.

The administration of systemic antibiotics is a coadjuvant measure (penicillin and its derivatives at high doses, or normal-dose doxycycline).

* Management of pediatric periodontal disease (23):

In periodontal disorders associated with neutropenia, Papillon-Lefevre syndrome and leukocyte adhesion deficiencies, the immune system of children is unable to control the growth of periodontal pathogens. Antibiotic treatment is therefore needed in such cases.

Cultures and susceptibility testing are useful for selecting the most appropriate drug in each case. Prolonged antibiotherapy is indicated for the management of chronic periodontal disease.

* Management of viral diseases (24):

Primary herpetic gingivostomatitis should not be subjected to antibiotic treatment unless there is clear evidence of secondary bacterial infection.

- *Patients with indications for antibiotic prophylaxis*

Antibiotic prophylaxis in healthy patients is indicated in the event of surgery in a highly contaminated location (e.g., periodontal surgery). Dental auto-transplantation is also carried out under antibiotic prophylaxis. In immunocompromised patients such prophylaxis always should be provided.

Table 1. Antibiotic prophylaxis regimens for pediatric patients. mg: milligrams; kg: kilograms; g: grams; IV: intravenous; IM: intramuscular.

ANTIBIOTIC PROPHYLAXIS REGIMENS	
Children not allergic to penicillin	Amoxicillin 50 mg/kg + clavulanic acid 6.25 mg/kg (maximum 2 g) oral route 1 hour before dental treatment.
Children not allergic to penicillin and with no problems for oral drug dosing	Amoxicillin 50 mg/kg + clavulanic acid 5 mg/kg (maximum 2 g) IV or IM, 30 minutes before dental treatment.
Children allergic to penicillin	Clindamycin 20 mg/kg (maximum 600 mg) oral route 1 hour before dental treatment.
Children allergic to penicillin and with problems for oral drug dosing	Clindamycin 15 mg/kg (maximum 600 mg) IV or IM, 30 minutes before dental treatment.

Table 2. Dental procedures in which antibiotic prophylaxis is advisable in pediatric patients.

Procedure	Prophylaxis risk patient (YES/NO)	Prophylaxis healthy patient (YES/NO)
Staples for absolute rubber dam isolation	YES	NO
Intraligamentous anesthesia	YES	YES
Truncal anesthesia	YES	NO
Extractions	YES	YES
Hemorrhagic dental repair: placement of splints and wedges.	YES	NO
Orthodontic band placement	YES	NO
Pulp treatment in deciduous and young permanent teeth	YES	YES
Hemorrhagic crown trimming: stripping, preformed crown placement	YES	NO

On administering an antibiotic on a prophylactic basis, the drug level in plasma must be far higher than when the antibiotic is used for therapeutic purposes. In this sense, the prophylactic dose recommended before surgery is double the therapeutic dose (13).

Antibiotic prophylaxis is advised in the following situations (9):

a) Patients with cardiac problems associated with endocarditis: many patients are at risk of suffering endocarditis following dental treatment, due to the prior existence of heart problems.

The American Academy of Pediatric Dentistry (AAPD) approved the guide for the prevention of bacterial endocarditis developed by the American Heart Association. This guide stresses that children with a history of intravenous drug administration (25), and children with certain syndromes (e.g., Down or Marfan syndrome), may be at risk of developing bacterial endocarditis, due to the associated cardiac anomalies (2,9).

b) Immunocompromised patients: these patients do not tolerate transient bacteremia following invasive dental management. Therefore, patients subjected to chemotherapy,

irradiation or bone marrow transplantation must be treated accordingly (26). This criterion also applies to patients with the following conditions: human immunodeficiency virus (HIV) infection, immune deficiencies, neutropenia, immunosuppression, anemia, splenectomy, habitual steroid use, lupus erythematosus, diabetes and organ transplants (2,9).
c) Patients with shunts, vascular catheters or prostheses: bacteremia following invasive dental treatment can give rise to shunt or vascular catheter colonization. Patient subjected to dialysis or chemotherapy, or who require frequent blood transfusions, are very susceptible to this problem (2,9).

- *Antibiotic selection*

Oral antibiotics that are effective against odontogenic infections comprise penicillin, clindamycin, erythromycin, cefadroxil, metronidazole and the tetracyclines (7). These antibiotics are effective against streptococci and oral anaerobes. Penicillin V is the penicillin of choice in cases of odontogenic infection. It is bactericidal, and although the spectrum of action is relatively limited, it is appropriate for the treatment of odontogenic infections. For the prophylaxis of endocarditis, associated to dental treatments, amoxicillin is the antibiotic of choice. Amoxicillin with clavulanic acid (clavulanate) can be used in certain cases, since it offers the advantage of preserving activity against the betalactamases commonly produced by microorganisms associated with odontogenic infections (9).

Clindamycin is an alternative in the case of patients who are allergic to penicillins. The drug is bacteriostatic, though bactericidal action is clinically achieved with the generally recommended dosage. The latest generation macrolides, clarithromycin and azithromycin can also be used if the child is allergic to penicillin. Cephalosporin cefadroxil are additional options when a broader spectrum of action is required. Metronidazole is usually used against anaerobes, and is characteristically reserved for situations in which only anaerobe bacteria are suspected. Tetracyclines are of very limited use in dental practice since these drugs can cause alterations in tooth color, they must not be administered to children under 8 years of age, or pregnant or nursing women (9).

- *Duration of antibiotic therapy in odontogenic infection*

The ideal duration of antibiotic treatment is the shortest cycle capable of preventing both clinical and microbiological relapse. Most acute infections are resolved within 3-7 days. When oral antibiotics are used, a high dose should be considered to secure faster therapeutic levels (27).

CONCLUSIONS

Prior to any dental treatment of children with some syndrome, medical problem or any other unfamiliar disorder, it is advisable to consult the pediatrician, in order to determine individual susceptibility to infections induced by bacteremias (2).

In recent years, the tendency is to reduce general antibiotic use for preventive or therapeutic purposes. This is based on the existing scientific evidence, and on professional experience. The development of bacterial resistances, doubts as to the efficacy of preventive treatments, and the possibility of toxic or adverse reactions to antibiotics have given rise to many questions about the risks and benefits of antibiotic use (9). The American Academy of Pediatric Dentistry has presented a series of clinical guides for the use of antibiotics in which conservative prescription is recommended, due to the growing prevalence of resistances (28).

In Spain, it would be recommendable to establish epidemiological vigilance systems to monitor such resistances. National periodic follow-up studies conducted on a multicenter basis are useful for establishing decisions regarding the best measures for avoiding the appearance and spread of bacterial resistances (29,30).

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