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Antibiotics in Odontogenic Infections - An Update

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Abstract

Odontogenic infection is an infection that originates within a tooth or in the closely surrounding tissues and can extend beyond natural barriers and result in potentially life-threatening complications. Spreading dental infections are routinely managed by endodontic or surgical intervention Antibiotic therapy is aimed as supportive measure for controlling the spread of infection and should be used judiciously. Proper understanding of disease process, oral and periapical microorganisms and pharmacokinetics is essential to prevent the overuse of antibiotics in dentistry.

Keywords: Odontogenic infections; Antibiotic

Introduction

Odontogenic infections are among the most common infections of the oral cavity. They can be caused by the sequlae of dental caries, periodontal disease or due to trauma. *Early recognition and management of acute orofacial infections is critical, because of rapid systemic involvement.* Odontogenic infections can lead to complications such as osteoperiostitis of the jaw, osteomyelitis, and deep fascial space infections [1,2]. *Odontogenic infections are typically polymicrobial in nature . It may be due to the fact that* the oral cavity contains a complex population of microorganisms. However, the anaerobes generally outnumber the aerobic bacteria by a factor of three to four folds [3].

Although bacteria play a major role in odontogenic infections, antimicrobials are not always warranted. Antibiotics in Dentistry are used for therapeutic and prophylactic reasons [4]. Therapeutic antibiotics are advised to treat infections in the oral cavity after local debridement has failed, whereas Prophylactic antibiotics are given to prevent diseases caused by oral flora, introduced to distant sites, which puts the host at risk. The antibiotics are advised depending upon the severity of the infection, patient's immune defense status, in case of acute infection, if inflammation is moderate and the process has progressed rapidly, in cases of diffuse cellulites with moderate-to-severe pain, or if the patient has signs of bacterimia, Antibiotics are also advised in medically compromised individuals, and in cases of trauma where the tooth has been reimplanted [5-7].

A draining abscess or a fistula containing a chronic infection usually requires only root canal treatment or extraction. However, other disease processes, including periodontal abscesses, pericoronitis, acute periapical abscesses and deep fascial space infections may require antimicrobial therapy. Antimicrobials must never be used as a replacement for appropriate surgical drainage and/or debridement, and should only be used as adjunctive therapy [1,2,7]. If Antimicrobial therapy is advised soon after diagnosis and before surgery, it can shorten the period of infection and minimize associated risks such as bacteremia [8].

Choice of Antibiotics

Several antibiotics are indicated for odontogenic infections. Proper understanding of disease process, treatment plan, mode of action of antibiotics (Table 1), patients health status, and pharmacokinetics and dose (Table 2) of the antibiotics is essential for a successful treatment outcome. The orally administered antibiotics are effective against odontogenic infections. They include amoxicillin, metronidazole, clindamycin etc.

Penicillin has been considered as first-line drug for odontogenic infections. Amoxicillin, semi synthetic penicillin is the drug of choice in treating dental infections and is the most common antibiotic used by dentists. If a patient with an early stage odontogenic infection does not respond to Amoxicillin, there is a strong probability of the presence of resistant bacteria. Bacterial resistance to penicillins is mostly as a result of the production of beta-lactamase by the bacteria. Whereas alteration of the target protein, enzymatic inactivation of the drug, bypassing of the target, preventing drug access to targets also can lead to resistance. In penicillin resistant cases beta-lactamase-stable antibiotics should be prescribed to the patient. These include either clindamycin or amoxicillin with clavulanic acid [1,9,10]. The American Heart Association considers amoxicillin to be the first choice for

Antibiotic	Mode of action
Amoxycillin	Inhibition of cell wall biosynthesis that leads to the death of the bacteria.
Metranidazole	Inhibits nucleic acid synthesis by disrupting the DNA of microbial cells
Cephalosporins	Inhibition of cell wall biosynthesis
Clindamycin	inhibits bacterial protein synthesis and is bactericidal at high dosages
Fluoquinolones	Interfere with bacterial DNA metabolism by inhibiting the enzyme topoisomerase

Table 1: Mode of action of commonly used antibiotics for odontogenic infections.

Antibiotics	Adults	Children
Amoxycillin	250-500 mg every 8 hours	20-40 mg/kg/day in divided doses every 8 hours
clindamycin	150-450 mg every 6 hours (maximum 1.8 g/day)	8-20 mg/kg/day in 3-4 divided doses
Metranidazole	7.5 mg/kg every 6 hours (maximum 4 g/24 hours)	30/mg/kg/day in divided doses every 6 hours
Amoxycillin with Clavulanic acid	500-875 mg every 12 hours	25-45 mg/kg/day in doses divided every 12 hours

Table 2: Dosage of commonly used antibiotics.

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Situation	Agent	Adults	Children
Oral	Amoxicillin	2 g	50 mg /kg
Unable to take Oral Medication	Ampicillin or Cefazolin or ceftriaxone	2 g IM* or IV† 1 g IM or IV	50 mg/kg IM or IV
Allergic to pencillins (oral)	Cephalexin or Clindamycin or Azithromycin/ Clarithromycin	2 g 600 mg 500 mg	50 mg/kg 20 mg/kg 15 mg/kg
Allergic to pencillin (unable to take oral medication)	Cefazolin/ Ceftriaxone or Clindamycin	1 g IM or IV 600 mg IM or IV	50 mg/kg IM or IV 20 mg/kg IM or IV
IM- Intramuscular; IV - Intravenous			

Table 3: Antibiotic prophylaxis for endocarditis and joint replacement therapies.

prophylaxis against the Endocarditis and prosthetic joint replacement therapy associated with dental procedures (Table 3) [1].

In long standing infections, gram negative anaerobic organisms may be suspected, therefore metronidazole may be added with amoxicillin. It can cause 'Antabuse' reaction such as nausea, vomiting and abdominal cramps in patients who consume alcohol during the medication period [1]. Metronidazole's excellent anaerobic gram negative activity and its low degree of toxicity, make it an excellent drug in the treatment of odontogenic infections [11,12].

Cephalosporins are broader spectrum antibiotic but they do not offer any advantage over amoxicillin in treating odontogenic infections [1]. Erythromycin wes used commonly for odontogenic infections. Side effect like gastric upset and because of high resistance of odontogenic microorganisms has led to fewer prescriptions for erythromycin in odontogenic infections [12]. The newer macrolides, clarithromycin and azithromycin, have improved pharmacokinetics compared to erythromycin, but they are not considered as first-line therapy in treating odontogenic infections. It can be used as a drug of choice in patients with penicillin allergy [11]. The American Heart association protocol does not consider erythromycin in recent protocols for prophylaxis for endocarditis, and is replaced by newer macrolides [13].

Tetracycline because of its side effects and widespread resistance is not commonly used to treat odontogenic infections. Newer drugs like Doxycycline and minocycline possess better anaerobic activity than tetracycline, but they should not be considered first-line therapy for odontogenic infections. Use of tetracycline in pregnant women and growing children can cause enamel defects in children [14].

Clindamycin has excellent broad spectrum of action. Its efficacy in treating odontogenic infections is comparable to Penicillins [1], It has been used successfully to treat patients when therapy with other agents has failed [15]. Several studies have demonstrated clindamycin's efficacy in preventing dry socket [16]. Clindamycin's broad spectrum of coverage with excellent clinical efficacy has prompted some standard drug guides to Antimicrobial Therapy to replace penicillin V with clindamycin as the drug of choice in treating odontogenic infections [1]. The American Heart Association recommends clindamycin, rather than erythromycin, to penicillin-allergic patients requiring endocarditis prophylaxis [13].

The drugs ciprofloxacin, norfloxacin, ofloxacin, and levofloxacin are bactericidal and have potent gram negative activity. But their activity against gram positive bacteria is poor. The use of ciprofloxacin and fluoroquinolones in pediatric patients has been limited due to arthropathy noticed in weight bearing joints. Due to the spectrum of organisms associated with odontogenic infections, the use of fluoroquinolones in the treatment of acute odontogenic infections should not be considered [1,17]. Moxifloxacin, a fourth generation fluoroquinolones has the highest rate of bacterial susceptibility among all antibiotics including penicillin and clindamycin for odontogenic infections. However, given its broad spectrum and high cost, it can be only considered as a second line therapy to penicillin V, metronidazole and clindamycin [18,19].

Antibiotic Concerns

As there is no clear guideline for use of antibiotics in dentistry, it has been misused or overused in most of the cases; therefore, antibiotic resistance is increasing [4]. The use of cepholosporins in patients with penicillin allergy was a cause of concern in the old literature, but latest studies show that there is only limited correlation between penicillin allergy to cephalosporin antibiotic. Most cross reactivity between penicillins and cephalosporins is because of the similarity of R1 side chains. Latest literature shows cross reactivity between penicillins and most second- and all third- and fourth-generation cephalosporins is negligible. The cross reactivity between penicillins and cephalosporins in individuals who report a penicillin allergy is approximately 1% and, in those with a confirmed penicillin allergy, 2.55% therefore if a patient is having an allergic response to penicillin, it is safe to administer a cephalosporin with a side chain that is structurally dissimilar to that of the penicillin or to administer a third- or fourth-generation cephalosporin [20].

Antibiotics should be used only for the management of active infection or to prevent the potential spread of infection. However, intravenous antibiotics and hospital admission should be strongly considered when swelling of the airway, swelling of the eyelid, or neck involvement is present, or the patient's level of activity and oral intake is decreased [7]. The routine use of antibiotics before or after extractions or endodontics is questionable. Therefore, routine prescription of antibiotics for every extraction or endodontic procedure must be discouraged. Always weigh the risks of resistance and allergy against any potential benefit [8].

Conclusion

Antibiotics are essential for control of odontogenic infections even though mechanical debridement of pulp tissues is necessary. It should be used judiciously and have to be limited for conditions which are really indicated. Amoxycillin continues to be the drug of choice. Proper understanding of disease process, microbiology of odontogenic infection and pharmacokinetics of the antibiotics is essential for successful therapy.

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