



Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Biomedicine

journal homepage: www.elsevier.com/locate/apjtb

Document heading doi:10.1016/S2221-1691(12)60222-6 © 2012 by the Asian Pacific Journal of Tropical Biomedicine. All rights reserved.

Indications of antibiotic prophylaxis in dental practice— Review

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ARTICLE INFO

Article history:

Received 15 January 2012

Received in revised form 22 January 2012

Accepted 14 March 2012

Available online 28 September 2012

Keywords:

Antibiotic prophylaxis

Odontogenic infection

Dental procedure

ABSTRACT

Antibiotics are frequently used in dental practice. Clinical and bacteriological epidemiological factors determine the indications of antibiotics in dentistry. Antibiotics are used in addition to appropriate treatment to aid the host defences in the elimination of remaining bacteria. It is indicated when there is evidence of clinical sign involvement and spread of infection. Antibiotics are prescribed in dental practice for treating odontogenic infections, non-odontogenic infections, as prophylaxis against focal and local infection. Special care needs to be addressed to patients with organ transplants, poorly controlled diabetes and pregnancy. Antibiotics should be used only as an adjunct to dental treatment and never alone as the first line of care. The present paper reviews the indications of antibiotics in dental practice.

1. Introduction

The discovery of antibiotics occurred in 1929 when the Scottish bacteriologist Alexander Fleming, working in a London teaching hospital, reported on the antibacterial action of cultures of a penicillium species. Antibiotics are the greatest contribution of the 20th century to therapeutics. Endodontics is the field of choice where antibiotics are used extensively[1,2]. The inflammatory process results in endodontic pain, which is most commonly related to microbial irritation, but can also be related to mechanical or chemical factors[3]. Judicious use of antibiotics in conjunction with surgical therapy is the most appropriate method to treat odontogenic infections. Medically compromised patients such as diabetics and organ transplant patients also require the service of antibiotics. Penicillin is the drug of choice in treating dental infections[4]. Narrow spectrum antibiotics should be considered the first choice as it produces less alterations in the gastrointestinal tract. There is often a dilemma among the dental practitioners concerning the use of antibiotics in conjunction with dental procedures. In this review article,

the indication of antibiotics in dental practice has been highlighted.

2. Indications of antibiotics

Antibiotics are not an alternative to dental intervention; they are adjunct[5,6]. Antibiotics are indicated when clinical signs of involvement are evident. The major use of antibiotic prophylaxis for dental procedures, are cases which cause bleeding in the oral cavity, has become a common practice among dentists[7]. Antibiotics are indicated in dental practice for treating immunocompromised patients, evident signs of systemic infection and if the signs and symptoms of infection progress rapidly[8].

2.1. Antibiotics for odontogenic infections

Penicillin is the drug of choice in treating odontogenic infections as it is prone to gram positive aerobes and intraoral anaerobes, organisms found in alveolar abscess, periodontal abscess and necrotic pulps. Both aerobic and anaerobic microorganisms are susceptible to penicillin[9]. Penicillinase-resistant penicillin or an ampicillin-like derivative is prescribed for infections caused by penicillinase-producing staphylococci or those involving

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gram-negative bacterial^[4]. A combinations of penicillin and clavulanic acid can be preferred for infections caused by staphylococcus, streptococci and pneumococci. Patients allergic to penicillin are treated with clindamycin 300 mg (65%) which is the ideal drug of choice and followed by azithromycin(15%) and metronidazole–spiramycin(13%)^[10]. The first generation cephalosporins like cephadroxil, cephadrine provide a broad spectrum antibiotic when gram positive organisms are suspected to be the causative factor of the infection. Cephalosporin is advisable for delayed-type allergic reactions to penicillin and when erythromycin cannot be used. Cephalosporin is indicated in endodontic practice as they exhibit good bone penetration^[11]. Tetracyclines are bacteriostatic antibiotics that specifically inhibit the binding of aminoacyl-t-RNA synthetases to the ribosomal acceptor site^[12]. For cases of acute necrotizing ulcerative gingivitis requiring systemic antibiotic therapy in which penicillin is precluded, tetracyclines are most beneficial. The side effects encountered most often by the usage of penicillin are hypersensitivity, which is found roughly in 3%–5% of the population^[13]. As with most antibiotics the occurrence of allergic reactions of all degrees of severity is common. The penicillins, followed by the cephalosporins and tetracyclines, are most frequently implicated in these reactions. Azithromycin has shown enhanced pharmacokinetics in encountering the anaerobes involved in endodontic infection. The oral dosage of azithromycin is 500 mg loading dose followed by 250 mg once a day for five to seven days^[14]. Ciprofloxacin is one of the common drugs used for endodontic infections. The effective action against oral anaerobes, gram positive aerobic organisms (*Staphylococcus aureus*, *Enterobacter* species and *Pseudomonas*) demands the need of ciprofloxacin for endodontic infections^[15]. Metronidazole is a synthetic antimicrobial agent, which is bactericidal and most effective against anaerobes. Baumgartner has shown effective number of bacteria resistant to metronidazole^[16]. The recommended dosage is 1 000 mg loading dose followed by 500 mg every six hours for five to seven days^[14]. Clindamycin remains the second drug of choice next to penicillin in treating odontogenic infections. It was observed that 10% of the *Streptococcus viridans* bacteria were resistant to clindamycin^[17]. Gilad *et al* developed a new clindamycin-impregnated fibers as an intracanal medicament, which is effective against other common endodontic pathogens^[18]. Due to its adverse side effects the routine use of clindamycin is not advised. However, beta lactum antibiotics still remain the drug of choice in odontogenic infections among the health professionals^[19].

2.2. Antibiotics for non-odontogenic infections

The non-odontogenic infections require a prolonged treatment. They include infections such as tuberculosis, syphilis, leprosy and non-specific infections of bone.

New synthetic antibiotics such as fluoroquinolones are the drug of choice for management of non-odontogenic infections. Fluoroquinones are indicated for bone and joint infections, genitourinary tract infections, and respiratory tract infections^[20]. They have a broad spectrum of action and inhibit bacterial DNA replication. Bystedt *et al* demonstrated high clindamycin concentration in human mandibular bone corresponding to doxycycline^[21]. Bone and anaerobic infections are managed by prescribing clindamycin (orally) or lincomycin (parenterally). Tuberculosis management requires a long duration of antibiotic service which includes ethambutol, isoniazid, rifampicin, pyrazinamide and streptomycin. Penicillin G benzathine is administered in the management of syphilis. Clofazimine, dapsone and rifampicin are used for treating leprosy.

2.3. Antibiotic prophylaxis to prevent infective endocarditis

Infective endocarditis is an uncommon but serious and often life threatening condition. The pathogenesis of infective endocarditis comprises of a complex sequence of events^[22]. Anatomic localization of infection is determined by the adherence of microorganisms to various sites^[23]. The coincidence between bacterial infection and endocarditis was described before the turn of 20th century^[24]. Studies have shown that dental procedures are trigger factors for few cases of endocarditis^[25,26]. A poor condition of the periodontal health is a substantial risk factor^[27]. Lockhart reported more incidence of infective endocarditis following dental extraction and periodontal surgery^[28]. Ottent *et al* reported that bacteremia was associated with 74% of patients following tooth extraction^[29]. Antibiotic prophylaxis not only acts by destroying bacteria, but also by inhibiting bacterial adherence^[30]. It is indicated in high risk dental procedures in patients with pre-existing high rate cardiac disorders^[31]. The standard regimen includes high doses of amoxicillin in children and adults, one hour before the dental treatment. 2 g of oral amoxicillin should be given to adults before the dental procedure commencement^[32]. Dajani *et al* have reported that 2g of amoxicillin provides several hours of antibiotic coverage^[33]. Clindamycin is recommended in patients allergic to beta-lactams^[34]. Moreover best results have been achieved by usage of clindamycin in treating odontogenic infections^[35]. In patients allergic to penicillin or amoxicillin, the first generation oral cephalosporin is recommended^[4]. Vancomycin and streptomycin are used prophylactically for prevention of infective endocarditis in patients with prosthetic heart valves. Prophylactic failure is possible to occur in patients with congenital heart disease if the proper antibiotic is not selected^[36]. The negligence to administer antibiotic prophylaxis for dental procedures may result in SBE and will lead to worst consequences for the patient. Cunha *et al* documented a similar case which, resulted in a cerebral vascular accident, embolic occlusion of the leg, and mitral valve replacement^[37]. On the other

hand, a reduction of 78.6% in prescribing antibiotics was noticed after the unveiling of NICE guideline[38]. The French agency for Health Product Health Safety advices against or contraindicates dental facial surgery, bone surgery, periodontal surgery, root canal treatment in these patients except under emergency situations, as these patients are prone to high risk of infection[39].

2.4. Antibiotic prophylaxis to treat local infection

There are various surgical procedures and medical conditions that are routinely covered by systemic antimicrobials which include impacted third molars, orthognathic surgery, implant surgery, periapical surgery, benign tumorsurgery and immunocompromised patients. The service of antibiotics in endodontics should be indicated for patients with signs of local infection and fever[6]. Evidence shows prescribing antibiotics after removal of impacted third molars reduce the severity of postoperative pain[40,41]. Abu-Taa *et al* compared the benefits of pre- and post-operative antibiotics in patients undergoing periodontal surgery. Pertaining to the post operative antibiotics, remarkable reduction in the post operative discomfort was noticed[42]. Amoxicillin 2 000 mg for five days at a suitable dose and interval helps to cover the treatment requirements after third molar surgery[43]. Studies show a decrease in postoperative infection, following the use of antibiotics after orthognathic surgery[44,45]. Danda *et al* evaluated the prophylactic value of single-dose antibiotic prophylaxis on postoperative infection in patients undergoing orthognathic surgery, compared to single-day antibiotics. The documented results were clinically significant[46].

Paluzzi *et al* have emphasized the need of antibiotic prophylaxis for implant surgery[47]. Studies reveal that 2 g of amoxicillin given orally 1 hour preoperatively significantly reduce failures of dental implants[48]. Rizzo *et al* analysed 521 endosseous implants placed under antibiotic coverage and reported efficient reduction in post operative infections[49]. Larsen *et al* mentioned that most surgeons have prescribed antibiotics pre and post operatively, still the incidence of infection is less in implant surgery[50]. Abduaziz *et al* compared the efficiency of prophylactic regimens commonly used in implant surgery. The prophylactic antibiotic use in implant surgery was of no credit over a single-dose preoperative antibiotic regimen in patients undergoing implant surgery[51]. Further the literature review performed by Sharaf *et al* also substantiates that single dose of pre-operative antibiotic coverage may slightly reduce the failure rate of dental implants[52]. On the other hand, Gynther *et al* revealed that no significance was appreciated after dental implant installation without antibiotic prophylaxis[53]. Nabeel Ahmad *et al* conducted a literature review on the effects of antibiotics in 11 406 implants. Fairly no advantage was evident from the use of antibiotic regimen[54]. The use of antibiotic regimen during implant placement is

controversial. As the surgical site of the periodontal surgery is contaminated with microorganisms, the use of antibiotics is quite necessary.

Immune compromised patients represent a special division for dental professionals as they are more prone to bacteremia, which may rapidly lead to septicemia[55]. Invasive dental procedure like dental extraction, deep periodontal scaling should be avoided whenever feasible[56]. The dental procedures performed for the immune compromised patients should be carried after interacting with the hematologic, oncologic and microbiologic consultants. Other indications requiring the need of antibiotic regimen before the commencement of dental procedures include dental implant placement, surgery beyond tooth apex, intraligamentary local anaesthetic injections and subgingival placement of antibiotic fibers. Antibiotic coverage is also mandatory for uncontrolled diabetic patients, who are more prone to invasive dental treatment[57]. Provided the risk factors are under control, patients with periodontal disease and diabetes can undergo implant treatment. The dentists play a vital role in treating medically compromised patients who undergo dental treatment. Because early detection of diabetes is ruled out during the treatment period[58]. It is the dentist's job to be involved in the health care team to further reduce the consequences of diabetes. Numerous studies have been undertaken on the correlation between prosthetic joint infection and dental procedure. LaPorte *et al* have justified the late onset infection in hip replacement patients and had a coincidence with the dental procedures[59]. Cephalexin 2 g given one hour preoperatively (dental procedure) is suggested for patients not allergic to penicillin and clindamycin 600 mg, one hour preoperatively for patients allergic to penicillin. Statistical data collected from the Medicare Beneficiary Survey reported that dental procedures do not pose a risk for patients undergoing prosthetic joint replacements[60]. Antibiotic prophylaxis is not recommended for all dental patients with total joint replacements, but advised for patients with an increased risk of haematogenous infections of prosthetic joints[61].

3. Antibiotic regimen with precaution

Consideration for antibiotic prophylaxis should be given for patients with kidney, liver failure and pregnancy. Hard or soft tissues of the mouth are affected in patients with chronic renal failure. Physician consultation is advised before and after organ transplant. Patients treated with corticosteroids for a long time may require an additional need of corticosteroids to prevent adrenal crisis. The dose is doubled if the patient is on 30–40 mg per day of hydrocortisone for a month. An additional supplement is not required if the dose is up to 30 mg per day of hydrocortisone. Dental treatment is safer, when performed three months after surgery. Six months is considered as the best time

and antibiotic prophylaxis is necessary if any invasive dental treatment is to be performed[62]. Dose adjustments are required in patients with kidney failure to avoid increased plasma drug concentration[63]. Penicillin, clindamycin and cephalosporin are the preferred antibiotics, with the dosing interval at a prolonged time[64]. Gudapati *et al* have suggested indomethacin, ibuprofen, naproxen and sodium diclofenac doses to be reduced or avoided in advanced stages of renal failure[65]. Codeine, morphine, fentanyl are prescribed with no reduction in their dosage[66]. Presence of periodontitis disturbs the renal function in kidney transplant patients[67]. Dialyzed patients are advised to get their dental treatment done on non-dialysis days, to ensure the absence of circulating heparin[68]. Kerr has updated that desmopressin is effective to control severe bleeding in renal patients[69]. Antibiotic prophylaxis is advisable before the invasive dental procedures are performed as these transplant patients are more susceptible to infection. The initial six months, after kidney transplant is considered unfavourable to do any elective treatment[65]. 25 mg of hydrocortisone administered intravenously reduces the risk of adrenal crisis in renal failure patients with stress[70].

Pertaining to kidney transplant, prevention of odontogenic inflammation should be initiated in the pre-dialysis period, because periodontal diseases are the predisposing etiology of atherosclerosis[71]. Patients with liver failure demand a dose reduction of erythromycin, clindamycin, metronidazole and anti-tuberculosis drugs. Oral zinc supplementation is effective in hepatic encephalopathy and consequently improves patients health-related quality of life[72]. Recent research further confirms that treatment of HE with oral L-ornithine-L-aspartate in cirrhotic patients considerably improved health-related quality of life[73]. Douglas *et al* have contraindicated the use of tetracyclines and anti-tuberculosis drugs in patients with liver failure[74]. The final category comprises of pregnancy, where tetracyclines and aminoglycosides usage is contraindicated as it leads to teratogenic effects on the foetus. ShROUT *et al* have emphasised the need of antibiotic prophylaxis for pregnant patients as it reduces the bacterial load of periodontal pathogens, also ensures good oral hygiene habits[75]. Azithromycin, cephalosporin, erythromycin, penicillin with or without beta-lactamase inhibitors are prescribed with caution during pregnancy. Haas *et al* have discussed about the drugs contraindicated for a lactating and pregnant patient where benzodiazepenes are contraindicated due to the risk of oral cleft developments during the first trimester[76]. The use of nonaspirin NSAIDs during early pregnancy is associated with statistically significant risk (2.4-fold increase) of having a spontaneous abortion. Risk of having a spontaneous abortion was also associated with gestational use of diclofenac, naproxen, celecoxib, ibuprofen and rofecoxib alone or in combination[77]. However, every gestational woman should be instructed to get medical and dental care during the course of her pregnancy, as failure to

do so may affect the health of both the mother as well as the foetus[78].

Antibiotic therapy is mandatory and essential in medicine and dentistry. Penicillin is the drug of choice in treating dental infections. Patients at high risk include those with infective endocarditis, immunocompromised conditions and dental procedures which may produce bacteremias. Invasive dental procedures if performed in such patients should be preceded with an antibiotic prophylaxis. Consultation with the physicians and specialists is required before any dental treatment is carried out in organ transplant and pregnant patients. Special caution needs to be addressed to the above patients to determine the best outcome of dental procedure and to provide the required dose adjustments and thereby preventing the complications in the dental clinic. And hence it is clear that apart from invasive dental procedures in high risk patients not all dental procedures require the need for antibiotic prophylaxis. Recommendations on antibiotic prescribing are essential to prevent overprescribing of antibiotic. The prescription of antibiotics should be considered adjunctive to the dental treatment.

Conflict of interest statement

We declare that we have no conflict of interest.

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