

Antibiotic prescribing in dental practice: Problems and recommendations.

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Abstract

Antibiotics are prescribed by dentists for treatment as well as prevention of infection. Indications for the use of systemic antibiotics in dentistry are limited since most dental conditions and diseases are best managed by operative intervention and oral hygiene measures. This paper addresses the problem of inadequate prescribing practices by dentists, due to a number of factors ranging from inadequate knowledge to social factors. Therefore, studies that investigated the pattern of antibiotic use by dentists worldwide were reviewed. The main defects in the knowledge of antibiotic prescribing were outlined. The conclusion was that, unfortunately, the prescribing practices of many dentists appear to be inadequate and this is manifested by over-prescribing. Recommendations to improve antibiotic prescribing practices are suggested in an attempt to help fighting the increasing incidence of antibiotic resistance, antibiotic allergies, and other side-effects of antibiotic abuse.

INTRODUCTION

Antibiotics are prescribed by dentists for treatment as well as prevention of infections. Dentists prescribe medications for the management of a number of oral conditions, mainly orofacial infections. Since most human orofacial infections originate from periodontal and dental structures, prescribing of antibiotics by dentists has become a vital aspect of dental practice and, as such, antibiotics account for the vast majority of medicines prescribed by dentists. Dental practitioners prescribe between 7% and 11% of all common antibiotics (betalactams, macrolides, tetracyclines, clindamycin, metronidazole, and fluoroquinolones). In the UK, for instance, dentists accounted for 7% of all community prescriptions of antimicrobials. Conversely, the National Center for Disease Control and Prevention estimates that approximately one-third of all outpatient antibiotic prescriptions are unnecessary^{3,8,9}.

Antibiotic prescribing may be associated with side-effects such as gastrointestinal disturbances, fatal allergic reactions, and development of resistance^{4,5,7}. The increasing resistance problems of recent years are probably related to overuse or misuse of

broad-spectrum agents such as cephalosporins and fluoroquinolones. These complications associated with antibiotics use have encouraged studies investigating antibiotic prescribing practices of dentists.

THERAPEUTIC ANTIBIOTIC PRESCRIBING BY DENTISTS

Most oral diseases are primarily inflammatory conditions that are associated with pain^{2,6}. A considerable percentage of dental pain originates from acute and chronic infections of pulpal origin, which necessitates operative intervention, rather than the use of antibiotics. Non-indicated clinical cases for antibiotic use include acute periapical infection, dry socket, and pulpitis. Chronic inflammatory periodontal conditions are also not indicated for antibiotics; systemic antimicrobials should only be used in acute periodontal conditions where drainage or debridement is impossible, where there is local spread of the infection, or where systemic upset has occurred^{1,6}.

Data reported from different countries show differences in dentists' knowledge of clinical situations indicated for antibiotic prescribing^{1,8,9,11-18}. Almost half or more of the dentists investigated in England, Kuwait, and Turkey would prescribe for dry socket. Another non-indicated condition is localized swelling, which

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was also among the conditions for which antibiotics were prescribed in Norway, South Australia, Kuwait, and England.

More common dental infections present in the form of pulpitis and periapical periodontitis, which require only operative measures like fillings, root canal therapy, or extraction if the tooth is not restorable. Unfortunately, some dentists still prescribe antibiotics for these conditions. An uncomfortable finding was that a number of dentists prescribe antibiotics for viral infections like herpes simplex virus-1 infections. Clinical situations that require antibiotic therapy on empirical basis are limited, and they include oral infection accompanied by elevated body temperature and evidence of systemic spread like lymphadenopathy and limitation of mouth opening.

There are also a limited number of localized oral lesions that are indicated for antibiotic use and these include periodontal abscess, acute necrotizing ulcerative gingivitis, and pericoronitis. Other aspect of antibiotic over-prescribing is prescribing based on non-clinical factors. Patient's expectation of an antibiotic prescription, convenience, and demand necessitated by the social background of the patients are considered unscientific reasons for antibiotic prescription. Whereas English and Scottish dentists would not prescribe for non-clinical factors^{8,9,31}, dentists in the Eastern Mediterranean region have shown a tendency to prescribe on a patient-demand basis.

The most commonly used antibiotics in dental practice are penicillins, with the most commonly prescribed one being amoxicillin, followed by penicillin V, metronidazole, and the association amoxicillin-clavulanic acid. Penicillin is still the gold standard in treating dental infections. Among the group of penicillins, penicillin V, amoxicillin, and amoxicillin-clavulanic acid (co-amoxiclav®) have been advocated for the treatment of odontogenic infections.

The frequency of prescribing is usually mentioned in the known resources for antibiotic prescribing²⁰. Duration of treatment recommended in therapeutic guidelines is commonly based on expert opinion. A survey in Canada found that the average duration of antibiotic use prescribed by dentists is 6.92 days²⁰. Another survey in the USA found that endodontists prescribe antibiotics for an average of

7.58 days^{13,22}. Recent studies on attitudes of dentists in the Eastern Mediterranean region showed that dentists preferred to prescribe a lower dosage of an antibiotic over a longer period^{1,15-18}.

In recent years, more attention has been given to short courses³. It is frequently suggested that short-course antibiotic therapy requires that antibiotics have certain characteristics, such as rapid onset of action, bactericidal activity, lack of propensity to induce resistant mutants, easy penetrability into tissues, activity against non-dividing bacteria, not being affected by adverse infection conditions (low pH, anaerobiasis, presence of pus, etc.), administration at an optimal dose, and optimal dosing regimen. A two-dose, 3-gm regimen of amoxicillin has been shown to be effective in certain situations. On the other hand, oral antibiotic use for 2 or 3 days has been advocated for the treatment of acute dentoalveolar infections, and in doses recommended by the British National Formulary (BNF). Indeed, in some cases, patients improved after 2 or 3 days of antibiotic therapy.

In general, reducing the frequency of antibiotic intake (without compromising the dose) has yielded improved results: a twice-daily dosage of amoxicillin/clavulanic acid had several advantages over the three times-daily dosage, including increased convenience, improved compliance, and improved tolerability.

Additionally, antibiotic short courses are preferred to long courses particularly when treating children since children's compliance with conventional courses is poor. A false conception about the use of antibiotics is that antibiotics should be used for a certain number of days to 'kill the resistant strains' as the vast majority of strains acquire resistance via transposable elements that are preferentially transferred when antibiotics are used in sub-therapeutic doses or for long durations. Therefore, antibiotics should be prescribed at the correct frequency, dose, and duration so that the minimal inhibitory concentration (MIC) is exceeded and side-effects and the selection of resistant bacteria are prevented. Prolonged courses of antibiotics destroy oral, pharyngeal, and gastro-intestinal commensal flora. Furthermore, longer durations of up to 21 days may result in the selection and development of resistant strains of bacteria and a reduction in the ability of the oral flora to resist the colonization by harmful micro-

organisms that are not normal residents, resulting to superimposed infections by multi-resistant bacteria and yeasts.

Prophylactic antibiotic prescribing

Prophylactic antibiotics, taken prior to a number of dental procedures, have been advocated to reduce the likelihood of postoperative local complications, such as infection, dry socket (post-extraction alveolar osteitis) or serious systemic complications (e.g infective endocarditis). The evidence for antibiotics acting to prevent infection from surgical wounds in the mouth is poor to non-existent, indicating that preoperative parenteral antibiotic prophylaxis for routine third molar surgery in medically fit patients is unwarranted. It was also found that a single dose of metronidazole was ineffective in preventing the development of dry socket. For most dentoalveolar surgical procedures in fit, non-medically compromised patients, antibiotic prophylaxis is not required or recommended.

In the case of bacterial endocarditis, the absolute risk rate after dental treatment, even in at-risk patients, is considered very low. This is consistent with recent guidelines from the British Society for Antimicrobial Chemotherapy³³ and the American Heart Association³⁴ which recommend that only patients in the high risk category require antibiotic coverage: the basis for this recommendation is:

- There is no consistent association between having an intervention, dental or non-dental, and the development of bacterial endocarditis.
- Regular tooth brushing almost certainly presents a greater risk of bacterial endocarditis than a single dental procedure because of repetitive exposure to bacteremia with oral flora.
- The clinical effectiveness of antibiotic prophylaxis is not proven.
- Antibiotic prophylaxis against bacterial endocarditis for dental procedures may lead to anaphylaxis.

It is important to note that most studies on prophylactic antibiotic use were carried out in developed countries^{3,4,8-14,19,31} and the results generally indicated that dentists have a good knowledge of prescribing. Although, the few studies conducted in developing countries^{1,15-18} reported that abuse of

prophylactic antibiotics was to prevent postoperative infection following surgical dental manipulations or to cover either a defect in aseptic clinical technique or improperly sterilized equipment and instruments.

Antibiotic resistance in dental practice

Bacteria have the ability to change and develop resistance to antibiotics which is either plasmid-mediated or maintained on the bacterial chromosome; this can happen in several ways including production of bacterial enzymes which inactivate antibiotics, modifications in the bacterial cell walls rendering them impermeable to antibiotics, activation of drug efflux pumps reducing the concentration of antibiotics in bacterial cells, and alterations in target sites for antibiotics.

The main reasons of growing antibiotic resistance^{21,23,31,32} include: overprescription of antibiotics in humans as well as livestock and fish farming, patients not completing their course of treatment, self-prescription including use of left-over antibiotics, poor hygiene and sanitation, and inadequate infection control in healthcare facilities including hospitals and clinics.

Unfortunately, there is lack of new antibiotics to target the growing populations of resistant bacteria. Current research is focused on developing alternate and new treatments to tackle antibiotic resistance including the use of probiotics, vaccines, bacteriophage therapy, inhibitors of drug efflux pumps, photodynamic therapy, and new classes of antimicrobial agents. However, most of these treatments are still under development and antibiotic resistance remains a massive challenge.

Most dental problems do not warrant antibiotic prescriptions and are best managed with appropriate operative treatment. Antibiotics should only be used as an adjunct to operative intervention when strictly indicated. Moreover, antibiotics do not compensate for poor operative treatment. When prescribing, dental practitioners need to consider dosage, duration, and recognition of adverse effects / contra-indications of antibiotics. Any temptation to prescribe antibiotics due to patients insisting on antibiotics must be avoided.

Dental pain resulting from pulpitis and localised endodontic infection does not warrant use of antibiotics and should be managed by operative treatment (root

canal treatment / tooth extraction if indicated) with appropriate analgesic coverage. Similarly, localised dental abscesses due to a pulpal or periodontal cause are treated by establishing drainage using appropriate methods (pulp access opening; surgical incision, or extraction of the offending tooth). Lastly, mild pericoronitis and dry socket (alveolar osteitis) do not require antibiotics and can be managed conservatively with curettage, irrigation, and analgesics.

Antibiotics may be required¹⁹ for patients presenting with acute necrotizing ulcerative gingivitis, aggressive generalized periodontitis, severe pericoronitis, rapidly progressing diffuse infection involving fascial spaces, severe limitation of mouth opening, and jaw osteomyelitis.

Patients with signs of a spreading orofacial infection should be referred to secondary care urgently and should not be managed in primary care. Indications for referral include: difficulty in breathing/swallowing due to diffuse swelling, severe malaise or toxic appearance with elevated temperature (>39°C), severe limitation of mouth opening, compromised host defences, and need for a general anaesthetic.

Allergies to antibiotics in dental practice

Adverse reactions to antibiotics prescribed or administered in dental practice can be worrying. Most of these reactions are somewhat predictable based on the pharmacodynamic properties of the drug. Others, such as allergic and pseudoallergic reactions, are generally unpredictable and unrelated to normal drug action^{35,36,37}.

Penicillins and cephalosporins are the most commonly used antibiotics in dental practice. Both have been confirmed as producing allergic and pseudoallergic reactions, but the actual incidence is well overstated³⁵. As many as 1 in 10 patients reports a history of allergy to penicillin, but up to 90% of these are able to tolerate penicillin and are designated “penicillin allergic” unnecessarily. Many patients claiming history of allergy to penicillin can tolerate cephalosporins. One might also consider the time elapsed since the allergic reaction occurred. It is not unusual for adults to offer a vague history of reaction as a child. Approximately 50% of patients with actual IgE reactions to penicillin lose their sensitivity after 5 years, and this increases to

80% after 10 years³⁸.

Issues regarding the potential for cross-allergenicity³⁹ between penicillins and cephalosporins were formerly thought related to the beta-lactam ring, but recent evidence has established that they are related more to similarities in the R side chains. It is generally accepted that patients having a history of IgE-mediated reaction to a penicillin drug should be managed using a non-beta-lactam antibiotic. Urticaria (hives) is IgE-mediated but accounts for only 10% of all exanthematous drug reactions. The overwhelming majority of cutaneous reactions to penicillins are pruritus or rash, and these are not IgE-mediated. Any potential for cross-reaction is unlikely. Although macrolides and clindamycin are conventionally considered the alternatives of choice in patients allergic to penicillins, the macrolides have become less attractive. It is preferable to substitute an alternate penicillin or cephalosporin for a patient claiming penicillin allergy, provided the nature of the reaction was merely pruritic (itch) or a maculopapular rash. A history of urticaria (hives) or anaphylactoid symptoms are more convincing evidence that the patient’s reaction to penicillin was truly IgE mediated, and in this case, there is little recourse but to refrain from prescribing any beta-lactam derivative.

Allergic or pseudoallergic reactions to other classes of antibiotics used in dentistry are more uncommon and less understood. Nonetheless, clinical reports of such reactions do appear in literature. Simply stated, a patient’s claim of a cutaneous reaction or airway compromise leaves little recourse but to avoid prescribing the offending drug.

RECOMMENDATIONS

Drainage is the recommended treatment for localized dentoalveolar abscess. Empirical antibiotic therapy and drainage are recommended for more severe infections such as facial cellulitis, pericoronitis, lateral periodontal abscess, and necrotizing ulcerative gingivitis. The type of antibiotic chosen and its dosing regimen are dependent upon the severity of infection and the predominant type of causative bacteria.

According to the BNF, amoxicillin is recommended for dental infections in doses ranging from 250 mg to 500 mg, every 8 hours. The use of 3 g amoxicillin repeated after 8 hours is also mentioned as a short course of oral

therapy. Another drug that is also recommended by the BNF is the association of amoxicillin with clavulanic acid, which can be used in doses ranging from 375 mg to 625 mg every 8 hours. However, in patients allergic to penicillin, clindamycin can be used in doses ranging from 150 mg to 450 mg every 6 hours. Another option for penicillin-allergic patients as recommended by the BNF is metronidazole, which can be used in a dose of 200 mg to 400 mg every 8 hours, for 3–7 days.

For severe odontogenic infections, higher doses of a broad-spectrum antibiotic may be required. Lewis³ has shown that only 5% of the main isolates from dental abscesses are resistant to amoxicillin/clavulanic acid.

Amoxicillin/clavulanic acid and clindamycin are the only orally administered antimicrobials with adequate pharmacokinetic/pharmacodynamic properties to be effective against the most commonly isolated oral pathogens for the treatment of orofacial infections^{2,6,40,41}.

Patients who are allergic to penicillin should benefit from clindamycin^{40,41}; it is active against some oral anaerobes and facultative bacteria and has the advantage of good bone penetration. However, increasing the dose may increase the possibility of serious side-effects such as pseudomembranous colitis, Sweet's syndrome, and neutropenia.

Infections with predominant anaerobic bacteria such as pericoronitis, periodontal abscess, and necrotizing ulcerative gingivitis are better treated with metronidazole. Other inflammatory/painful oral conditions such as cracked tooth, dentine hypersensitivity, and bacterial sialadenitis are outside the scope of this paper.

In addition to the proper dosing regimens and professionally responsible prescribing practices, the general public needs to be educated about the importance of restricting the use of antibiotics to only cases of severe infections. Patients have become used to being given an antibiotic for a range of medical complaints. Unfortunately, patients presenting at dental surgeries also routinely expect an antibiotic for the treatment of toothache.

Dental patients not only pressure their dentist to get an antibiotic prescription, but they often self-medicate; self-medication with antibiotics was found to be alarmingly high in some developing countries.

In conclusion, prescribing practices of dentists can be improved by increasing awareness among them on the

recommended guidelines. Furthermore, the importance of initiating awareness programs among the general public should be encouraged.

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