Clinical Update

Naval Postgraduate Dental School
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8955 Wood Road
Bethesda, Maryland 20889-5628

Vol. 38, No. 3 July 2016

Antibiotic Use in Endodontics

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Introduction

The introduction of antibiotic medications has led to significant changes in healthcare practice. Many bacterial infections that were once almost certainly lethal can now be treated with these medications. These substances have rapidly become some of the most commonly overused and misused medications by clinicians.[1] Antibiotics are often inappropriately prescribed based on patient expectations, fear of litigation, and the belief that broad-spectrum antibiotics are more effective than narrow-spectrum agents.[2] The aim of this Clinical Update is to aid clinicians in their understanding of the risks and benefits of antibiotic treatment and to assist in the proper use and selection of antibiotic medications when treating well-localized endodontic infections.

Risks

One common complication associated with antibiotics is true allergic reaction. One report showed 17.3% of hospitalized patients report being allergic to a β-lactam antibiotic, with 15.6% reporting penicillin (PCN) allergies.[3] Many of these patients, in fact, are not truly allergic to these medications. Since a true allergy may complicate or limit therapeutic options, verification of the allergy may be necessary. The patient should be questioned regarding the nature of previous reactions, how long ago the reaction occurred, and when the symptoms occurred in relation to medication intake. Knowledge of the symptoms of allergic response (urticaria, angioedema, bronchospasm, gastrointestinal symptoms, rhinitis, conjunctivitis, anaphylaxis) and known medication side effects may help the clinician differentiate between a true allergy and a less threatening sensitivity or side effect. If further confirmation is needed, allergy testing by skin tests, in vitro tests, or drug provocation tests may be considered.[4]

Medication side effects may be related to their therapeutic effects. Gastrointestinal and urogenital symptoms, for example, may be the consequence of altering the patient's native microbial ecology. Therefore, reports of diarrhea or candida infections do not absolutely contraindicate the use of the associated antibiotic.

While media coverage over recent years has served to educate the public regarding the presence of antibiotic resistant strains of *S. aureus*, microbial resistance has been a problem since the introduction of the first antibiotics. Of 14 classes of antibiotics introduced since 1936, resistance has been observed in all groups within 7 years of introduction.[5] Bacteria can acquire resistant genes by spontaneous mutation, horizontal gene transfer, or absorption of genetic fragments to form mosaic genes. These genetic alterations result in antibiotic inactivation, alteration or reduction of membrane drug target receptors, or alteration of microbial membrane permeability.[6] The reported prevalence of PCN-resistant bacteria in odontogenic infections increased from 33% in 1991 to 54% in 2006. Reports of clindamycin-resistant odontogenic infections have also increased.[7] Fortunately, 87% PCN susceptibility has been reported for strains of *Viridans streptococci*.[8] Such facultative streptococci are the predominant species during the initial 3 days of many odontogenic infections.[9] PCN remains an effective antibiotic, especially for treating early odontogenic infections. As an infection matures, PCN-resistant obligate anaerobes assume a more dominant role.[10] In 2006, Flynn et al. reported a 26% clinical failure rate for PCN in hospitalized patients with odontogenic infections.[7]

Fortunately, emergence of resistant bacteria can be greatly reduced by practicing "antimicrobial stewardship", which involves consideration of risks and interactions while avoiding superfluous prescription of antibiotics.[11]

Indications and Contraindications

In order to limit inappropriate antibiotic prescriptions, an accurate diagnosis must be established. A proper diagnosis will aid the clinician in determining whether antibiotic treatment is justified. Antibiotics should be considered an adjunctive treatment, used in conjunction with procedures that address the etiology of infection. For localized endodontic infections, a pulpectomy, without incision for drainage (I&D), is typically the treatment of choice, and systemic antibiotics are usually not necessary. Systemic antibiotic treatment should be reserved for patients with compromised host resistance or those who exhibit systemic symptoms of infection. These symptoms include fever, malaise, cellulitis, fascial space infection, trismus, and progressive or persistent swelling.[1]

Antibiotic therapy does not treat pain, and is therefore not appropriate for treating irreversible pulpitis (IP).[12] Teeth diagnosed with IP should be treated by pulpectomy, and pain management can generally be accomplished with non-steroidal anti-inflammatory medications. The routine prescription of antibiotics following root canal therapy, even in cases of symptomatic teeth with pulp necrosis without systemic involvement, is not indicated, and has no significant influence on postoperative pain or swelling.[13] Patients with necrotic pulps and sinus tracts generally recover well after pulpectomy. Patients with localized swelling usually require I&D treatment. Addition of antibiotics to the I&D of a well localized swelling is not warranted and has failed to demonstrate any therapeutic benefit.[14] The use of antibiotics as prophylaxis against endodontic flare-ups has not demonstrated any effectiveness and should not be part of routine practice.[15]

Selection

If a diagnosis indicates antibiotic therapy is appropriate, the clinician must choose the proper medication and regimen. Culture and sensitivity (C&S) testing is the ideal method for choosing an antimicrobial medication. Unfortunately, waiting for C&S results is generally impractical, leading to empiric prescription based on commonly associated bacteria. Endodontic infections are characterized by polymicrobial biofilms consisting predominantly of species that are susceptible to penicillins.[1, 16] A loading dose, given at the onset of therapy, may be necessary for achieving a desired plasma drug concentration more rapidly.[17]

Penicillin VK (PenVK) has an appropriate narrow spectrum of action against bacteria commonly associated with endodontic in-

fections with relatively low host toxicity. PenVK is, therefore, the drug of choice in the treatment of endodontic infections with systemic symptoms.

Example: Rx: Penicillin VK 500mg
Sig: Take 2 tabs po immediately, followed by 1 tab q6h for 7 days

Some clinicians favor **amoxicillin**, due to its increased serum drug level and duration of therapeutic serum concentration.[18] However, its wider-spectrum of activity selects for more gastrointestinal bacteria, which may lead to unnecessary side effects. Amoxicillin may be warranted in some immunocompromised patients and may be prescribed with or without the β-lactamase inhibitor, clavulanate potassium.

Example: Rx: Amoxicillin 500mg
Sig: Take 2 tabs po immediately, followed by 1 tab q8h for 7 days

If prescribing amoxicillin with clavulanate potassium (Augmentin®), note that both 250mg and 500mg tablets contain the same amount of clavulanate potassium. Therefore, taking two 250mg tablets of Augmentin® is not equivalent to one 500mg tablet. A loading dose should be made by adding plain amoxicillin to the initial dose.

Clindamycin is the drug of choice for use in patients with PCN allergies. It is effective against facultative and strict anaerobes and concentrates in bone. While reports have associated clindamycin with increased incidents of pseudomembranous colitis, it is important to note that other antibiotics, especially cephalosporins, may also contribute to this side effect.[1]

Example: Rx: Clindamycin 300mg
Sig: Take 2 tabs po immediately, followed by 1 tab q6h for 7 days

If symptoms do not improve within 2-3 days of initiating antibiotic treatment, the diagnosis and treatment plan should be thoroughly reviewed to ensure proper infection management of the patient. The addition of **metronidazole*** to PCN or clindamycin may be helpful. Metronidazole is very effective against strict anaerobes, but alone has little influence on facultative bacteria. Significant resistance to metronidazole alone has been reported, but when used in combination with PCN or amoxicillin, it is 93% and 99% effective against endodontic bacteria.[16] Patients who are prescribed metronidazole should be warned that consumption of alcohol while taking the medication results in a disulfram reaction and immediate "hangover."[1]

Example: Rx: Metronidazole 500mg
Sig: Take 2 tabs po immediately, followed by 1 tab q6h for 7 days

*Taken concurrently with PCN or clindamycin

Prescribing a higher dose of medication for a shorter period results in faster resolution and less drug resistance when compared to low dose regimens over a long period of time.[1] Antibiotic regimens should be continued for 2-3 days after resolution of symptoms, which generally justifies a 6-10 day course. Patients should be followed up daily. If improvement is not evident within 48 hours, the diagnosis should be reviewed, and a specialist consult should be considered. Severe or persistent infections, fascial space infections that threaten the patient's airway, or those requiring extraoral drainage should be referred to an oral and maxillofacial surgeon who is qualified to manage such conditions.[1]

Conclusion

Antibiotics are a valuable adjunct to appropriate treatment of endodontic infections with systemic involvement. Use and misuse of antibiotics may result in risks for the individual, as well as global consequences. Practicing "antimicrobial stewardship" aids in minimizing such risks and involves prescribing appropriate medications only when indicated by the diagnosis, thus avoiding fixed antibiotic prescribing behaviors. Systemic antibiotics are not a substitute for pulpal debridement and drainage, and should not be prescribed when local measures are sufficient for treatment of the pulpal and apical conditions. Patients with a systemic infection should be prescribed an effective dose of a suitable antibiotic for an appropriate duration. Symptoms that do not improve over the first 1-2 days may require drug substitution, additional medication, or referral to oral surgery for specialized care.

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