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The Current Concepts in the Use of Antibiotics in Dental Practice

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Abstract

The antibiotics are used in the management of life threatening infections since many decades. The antibiotics are indispensable drugs in the management of oral &maxillofacial infections. Over the years, several new concepts are been formulated in the principles of antibiotic therapy. This review article we will discuss about the current principles in the antibiotic therapy for management oral & maxillofacial infections. We will also discuss about complications and myths about use of antibiotic drugs.

Keywords: Antibiotics; Oral &maxillofacial infection; Dental management; Drugs

INTRODUCTION

Antibiotics are the miracle drugs used in the dental practice for dental, periodontal and oral mucosal infections. Most of the dental surgical treatments involve use of antibiotics to prevent or treat infections. The antibiotics have become indispensible in our dental practice. A thorough knowledge about the antibiotics is very much essential in our dental practice for successful dental treatment. In this article, we will discuss about the proper use of the antibiotics in our dental practice.

Understanding antibiotics:

- Antibiotics are used inappropriately in 75% of cases involving dental conditions.[1]
- Antibiotics and other modes of therapy will fail if the source of infection is not removed.[2]
- Dental/Surgical procedures should always be the first line of care, with antibiotics serving as adjunctive therapy.[3]
- Antibiotics are not a replacement for surgical drainage or debridement

The proper use of antibiotics needs to understand

1. What is an antibiotic?
2. Why we should use an antibiotic?
3. When we should use an antibiotic?
4. How we should use an antibiotic?

1. What is an antibiotic?

Historically, the term antibiotic referred to antimicrobial drugs produced by living organisms (bacteria or fungi) because of their natural metabolism, where as chemotherapeutic referred only to artificial prepared antimicrobial agents. Today all natural antibiotic are chemically modified (semi synthetic) to improve their pharmacokinetic properties, making the distinction between antibiotics and chemotherapeutic agents obsolete. The current trend is to use the words antibiotic and antimicrobial agent for all antimicrobial drugs, regardless of their origin.

The use antimicrobial agent is based on selective toxicity, which means that they severely damage microorganisms but, ideally, have no effect on eukaryotic cells (human cells).

Table 1: Classification of antibiotics according to mode of action

Antimicrobial activity	Antimicrobial agent
Antimetabolic	Sulfonamides, trimethoprim
Cell wall inhibitor	Pencillins, cephalosporins, vancomycin
bacterial protein synthesis inhibitor	Tetracyclins, clindamycin, aminoglycosides
DNA gyrase inhibitor	Naladixic acid, ciprofloxacin, ofloxacin

Characteristic of the ideal antibiotic

- Is selectively toxic to the microbe but non toxic to eukaryotic cells
- Is bactericidal rather than bacteriostatic
- Remains relatively soluble and active even when highly diluted in body fluids
- Remains active long enough to be effective
- Does not easily induce antimicrobial resistance

- Complements and assists the activities of host's defense
- Does not induce allergies in the host
- Does not affect the commensal microflora to a notable extent
- Has minimal to no drug interactions or adverse effects

2. Why we should use an Antibiotic in our dental practice?

Antibiotics are widely used in our dental practice. The use of antibiotics has specific indications.

- Antibiotics are used support the host defense mechanism.
- Control the severity and complications of infection
- As a prophylactic

The human defense mechanism fights against the invading pathogens causing infection. This involves cellular defense mechanism and non-cellular defense mechanism involving several enzymes, proteins and other chemical agents synthesized by the body. We use antibiotics to support the host's defense mechanism especially in cases of compromised defense mechanism due to systemic diseases. The presence of virulent microorganisms also demands the use of antibiotics.

Antibiotics are used in the management of infections to control the severity of infection and to prevent complications of infections.

Antibiotic prophylaxis is the administration of antibiotics to patients who have no known infection for the purpose of preventing microbial colonization and reducing the potential for postoperative complications.

3. When we should use an antibiotic?

The antibiotics are drugs which should be used judiciously and only when indicated. One should not use antibiotics in case of pure inflammation condition like pulpitis. The common indications for the use of antibiotics are

- When signs & symptoms are indicative of presence of infection
- The medical history or systemic examination reveals the presence of disease affecting the host defense system. E.g: Diabetes mellitus, Chronic renal failure, alcoholism, chronic liver disease, aging, patient on corticosteroids, HIV/AIDS, leukemia & patients who have undergone chemotherapy/radiation therapy etc.
- When clinical examination of the patient reveals presence of infection
- As a prophylactic therapy

Antibiotics should be used only in the presence of infection. The dental surgeon should take a detail history and thorough systemic, local & radiographic examination to diagnose the disease as infection. In addition, one should do hematologic, serologic & other laboratory examination whenever necessary to diagnose & to evaluate the origin or severity of oral & maxillofacial infection.

Principles of antibiotic prophylaxis

- Benefits from prophylaxis outweigh the risks of antibiotic-related allergy, toxicity, super infection, and the development of drug-resistant microbial srains.[4]
- An antibiotic loading dose should be used
- The antibiotic should be selected based on the organism most likely to cause an infection.[5]
- Before spread of micro organisms, the antibiotic should be present in the blood and target tissue.[6]
- Antibiotic prophylaxis should be continued as long as contamination from the operative site persists.[7]

The dental surgeon should always refer the latest guidelines of American heart Association (AHA Guidelines)[8] for Antibiotic prophylactic regimen for dental procedures on patients recommended for prophylaxis. The following table 3 & 4 shows the latest updates in the AHA guidelines as on May 2007, the cardiac conditions associated with the highest risk of adverse outcome from endocarditis for which prophylaxis with dental procedures is reasonable and dental procedures for which endocarditis prophylaxis is required.

Table 2: Cardiac conditions associated with the highest risk of adverse outcome from endocarditis for which prophylaxis with dental procedures is reasonable (May 2007)[8]

Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
Previous infective endocarditis
Congenital heart disease (CHD)* • Unrepaired cyanotic CHD, including palliative shunts and conduits • Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure† • Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
Cardiac transplantation recipients who develop cardiac valvulopathy

***Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD.*
†Prophylaxis is reasonable because endothelialization of prosthetic material occurs within 6 months after the procedure.

Table 3: Dental procedures for which endocarditis prophylaxis is required (May 2007)[8]

All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or per-foration of the oral mucosa. Procedures like Dental extractions, Periodontal procedures, Endodontic instrumentation, Prophylactic cleaning, Initial placement of orthodontic bands (not brackets)
The following procedures and events do not need prophylaxis: routine anesthetic injections through non-infected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth, and bleeding from trauma to the lips or oral mucosa.

Table 4: Antibiotic regimens for a dental procedure[8]

	Regimen: Single Dose 30 to 60 min Before Procedure		
Situation	**Agent**	**Adults**	**Children**
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	AmpicillinorCefazolin ceftriaxone	2 g IM or IV 1 g IM or IV	50 mg/kg IM or IV 50 mg/kg IM or IV
Allergic to penicillins or ampicillin—oral	Cephalexin*† Clindamycin Azithromycin or clarithromycin	2 g 600 mg 500 mg	50 mg/kg 20 mg/kg 15 mg/kg
Allergic to penicillin or ampicillinand unable to take oral medication	Cefazolin or ceftriaxone† Clindamycin	1g IM or IV 600 mg IM or IV	50mg/kg IM IV 20 mg/kg IM or IV

IM*: indicates intramuscular* ***IV****: intravenous.*

** Or other first-or second-generation oral cephalosporin in equivalent adult or pediatric dosage.*

† Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria withpenicillins or ampicillin.

Table 5: Summary of Major Changes in Updated Document (May 2008)[8]

We concluded that bacteremia resulting from daily activities is much more likely to cause Infective endocarditis than bacteremia associated with a dental procedure.
We concluded that only an extremely small number of cases of Infective endocarditis might be prevented by antibiotic prophylaxis even if prophylaxis is 100% effective.
Antibiotic prophylaxis is not recommended based solely on an increased lifetime risk of acquisition of Infective endocarditis.
Limit recommendations for Infective endocarditis prophylaxis only to those conditions listed in Table 3.
Antibiotic prophylaxis is no longer recommended for any other form of CHD, except for the conditions listed in Table 3.
Antibiotic prophylaxis is reasonable for all dental procedures that involve manipulation of gingival tissues or periapical region of teeth or perforation of oral mucosa only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from Infective endocarditis (Table 3)
Antibiotic prophylaxis solely to prevent Infective endocarditis is not recommended for GU or GI tract procedures
Although these guidelines recommend changes in indications for IE prophylaxis with regard to selected dental procedures (see text), the writing group reaffirms that those medical procedures listed as not requiring IE prophylaxis in the 1997 statement remain unchanged and extends this view to vaginal delivery, hysterectomy, and tattooing. Additionally, the committee advises against body piercing for patients with conditions listed in Table 3 because of the possibility of bacteremia, while recognizing that there are minimal published data regarding the risk of bacteremia or endocarditis associated with body piercing.

4. How we should use an antibiotic?

The antibiotic drugs are miracle life saving drugs only when used properly and judiciously. The antibiotics are associated several fatal complications if they are used improperly. The complications associated with the use of antibiotics will be discussed later in this article. Hence, the dental surgeon should know how to use these miracle drugs properly by understanding two basic principles.

1. Principles of choosing the appropriate antibiotic
   A. Identification of the causative organism
   B. Determination of antibiotic sensitivity
   C. Use of specific, narrow spectrum antibiotic
   D. Use of the least toxic antibiotic

E. Patient drug history

F. Use of bactericidal rather than a bacteriostatic drug

G. Use of the antibiotic with a proven history of success

H. Cost of the antibiotic

I. Ensure that patient completes the antibiotic course

2. Principles of antibiotic administration

a) Administer proper dose

b) Proper time interval

c) Proper route of administration

d) Consistency in route of administration

e) Combination antibiotic therapy

Principles of choosing the appropriate antibiotic:

1) Identification of the causative organism:

The pathogenic organism may be determined scientifically either in the laboratory where the organism can be isolated from blood, tissue or pus. The antibiotic therapy will be either initial (empirical) or definitive, depending on whether the organism is identified precisely. Initial empirical therapy may be instituted with a fair degree of Reliability if the following criteria where the site and features of the infection have been well defined, the circumstances leading to the infection are well known and the organism that most commonly cause such infections are well known. The definitive antibiotic therapy done after identifying the causative organism. The situations in which culture should be performed to identify the causative organism include the following: 1) if the patient has received appropriate treatment for 3 days without improvement, 2) if the infection is a post operative wound infection, 3) if the infection is recurrent, 4) if actinomycosis is suspected, 5) if osteomyelitis is present.

2) Determination of antibiotic sensitivity:

In the treatment of an infection that has not responded to initial antibiotic therapy or postoperative wound infection, the causative agent must be precisely identified, and the antibiotic sensitivity must also be determined. The results of the studies provide the information needed to describe the most appropriate antibiotic.

The penicillin is excellent for treatment of Streptococcus infection and is good to excellent for major anaerobes of odontogenic infections. Erythromycin is effective against Streptococcus peptostreptococcus and prevotellaand is ineffective against fusobacterium. Clindamycin is good for Streptococcus and for the 5 major anaerobic groups. Cephalexin is only moderately active against Streptococcus good person and is good too very good against the five groups of anaerobes. Metronidazole has no activity against Streptococcus but has excellent activity against the five anaerobic groups.

3) Use of specific, narrow spectrum antibiotic:

Selection of an antibiotic should be based on consideration of several factors. First the antibiotic with the narrowest antibacterial spectrum should be chosen. The use of narrow spectrum antibiotics also reduces the chance of development of bacterial resistance. Thus for a given streptococcal infection pencillin would result in less exposure of the host Flora to antibiotics than would a broader spectrum cephalosporin. The use of narrow spectrum antibiotic also minimises that is cough super infections. Use of narrow spectrum antibiotics allows larger proportions of the host flora to be maintained, thereby reducing super infections to a minimum.

4) Use of the least toxic antibiotic:

The choice of antibiotic drug to be used should be the least toxic truck from among those that are effective. The bacteria that causes odontogenic infections are usually sensitive to penicillin and chloramphenicol. Since chloramphenicol is known to be very toxic causing bone marrow depression, the penicillin should be the drug of choice even though chloramphenicol is slightly more effective than penicillin.

5) Patient drug history:

The knowledge of the patient drug reaction is very critical which involves history of previous allergic reactions and previous toxic reactions. If the patient had a documented anaphylactic Type 1 allergic reaction to pencilin, a cephalosporin should be avoided. Conversely if the patient had a less severe reaction to penicillin antibiotic the cephalosporins can more than likely to be used safely. Antibiotics made prolong, enhance, or interfere with the other medication that the patient is taking. Hence it is very important to have a clear knowledge about the patient's drug history before prescribing the antibiotics.

6) Use of bactericidal rather than a bacteriostatic drug:

The antibiotic therapy just reduces the bacterial challenge in a patient and the patient's known host defence is the one which completes the treatment by fighting against the infection. The advantages of the bactericidal antibiotics are 1) Lessreliance on host resistance, 2) killing of the bacteria by the antibiotic itself, 3)faster results than with bacteriostatic drugs, 4) greater flexibility with dosage intervals. It is very important that bacteriostatic drugs be given according to a rigorous time schedule. When bacteriostatic antibiotics are used the host defences must play a more important role in the eradication of the bacteria. For example the bactericidal drugs such as pencil or a cephalosporin should be used in immunodeficient patients instead of the bacteriostatic drugs like

Erythromycinor clindamycin for the treatment of bacteria susceptible to all four agents.

7) Use of the antibiotic with a proven history of success:

The critical observation of the clinical effectiveness of the drug penicillinover a prolonged period for treating oral infections shows that the drug penicillin has been very effective with a low incidence of adverse reactions. The tetracyclines, Erythromycin, lincomycin and clindamycin all have been claimed to be superior. However the historically proven overall performance of penicillin has not been surpassed in the treatment of most odontogenic infections. New antibiotic may be more active at lower concentration thus reducing the cost and dose related toxicity reactions, may be less toxic or it may have less bothersome side effects than the older antibiotic. Hence the newer antibiotics should be used only when they offer clear advantages over the older ones.

8) Cost of the antibiotic:

When it comes to health it is difficult to place a price tag on it but the treating clinician should consider the cost of the antibiotic prescribed. The more expensive antibiotics maybe the drug of choice in some situations but sometimes there may be a substantial difference in price for drugs of equal efficacy.

9) Ensure that patient completes the antibiotic course:

Sometimes the patients fail to take the medication in the way in which it was prescribed. The studies have action that the patient compliance decreases with increasing number of pills per day. If the prescription is for once daily administration patient compliance is approximately 80%. However when it is necessary to take the pill twice daily complaince decreases to 69% and drops even further to 35% for four times daily. Therefore if there is a choice a nation should prescribed fewest times daily to improve patient compliance.

Principles of antibiotic administration:

1) Administer proper dose

The goal of any drug therapy should be to prescribe or administer sufficient amounts to achieve the desired therapeutic effect but not enough to cause injury to the host. The minimal inhibitory concentration (MIC) of an antibiotic for a specific bacterium has been well established in the laboratory. For therapeutic proposes the big concentration of the antibiotic at the site of infection should be 3 to 4 times the MIC. Therefore the dosage prescribed must be capable of establishing a concentration of antibiotics that is 3 to 4 times the MIC. The usual recommended dose of an antibiotic is usually sufficient to provide a threshold MIC concentration against the common susceptible organisms. Therapeutic levels greater than 3 to 4 times the MIC generally do not improve the therapeutic results. Administration of dosas above that level increases the likelihood of toxicity and is wasteful.

Increased doses may be justified when the site set of infection may be isolated from the blood supply as an abscess formation or a nonvital tissue. These high plasma concentration may allow a greater amount of antibiotic to reach the shield of bacteria by simple diffusion.

2) Proper time interval

The frequency of dosing is also of importance in administration of antibiotics. Each antibiotic has an established plasma Half Life, during which one half of the absorbed dose is excreted. The usual dosage interval for the therapeutic use of antibiotics is 4 times the plasma Half Life. For example the plasma half life for Amoxicillin is almost 2 hours. Thus the time interval between doses should be 8 hours. Because most antibiotics are eliminated by the Kidneys the patient with pre-existing renal disease and subsequent decreased clearance may require longer intervals between doses if overdosing is to be avoided, for if the usual dosage schedule is maintained excessive plasma levels and a resultant increase in toxicity reactions occur. An alternative treatment plan would be to use and antibiotics that is excreted by the liver, such as Erythromycin.

3) Proper route of Administration

The oral route of administration of antibiotics results in the most variable absorption. Most antibiotics should be taken in the costing state 30 minutes before or 2 hours after a meal for maximum absorption. In some infections only parenteral administration produces the necessary serum level of antibiotic. When long term parenteral administration is necessary use of the intravenous route should be considered.

4) Consistency in route of Administration

Maintenance of peak blood levels of antibiotic for an adequate period is important to achieve maximum tissue penetration effective bacterial killing. Bacteria usually are not educated until the antibiotic has been given for 5 to 6 days. Thus, the recurrence of the infection is more likely by switching from parenteral to the oral route on the second or third day of antibiotic therapy. After the fifth day of parenteral Administration the blood levels achievable with the oral administration are usually sufficient. If the infection is mild enough not to require parenteral therapy initially, the blood levels achievable with oral therapy are sufficient.

5) Combination Antibiotic Therapy

Recombination antibiotic therapy should be used only when it is clearly indicated fistly as in case when it is necessary to increase the antibacterial spectrum in patients with life-threatening sepsis of unknown cause. The second situation when increased bactericidal effect against a specific organism is desired. The third situation which demands the use of combined antibiotic therapy is in the prevention of the Rapid emergence of resistant

bacteria. The fourth situation is in the temperate treatment of certain odontogenic infection. If the patient has a severe cellulitis and abscess type of infection, that is a rapidly progressive posteriorly around the lateral and then it becomes very necessary to give paranteral penicillin G and parenteral metronidazole. This combination therapy provides rapid bactericidal activity against both streptococci and anaerobes.

Therapeutic uses of antibiotics in oral-maxillofacial surgery.

As a general guideline antibiotic therapy should be reserved for those patients with clearly established infections who have a systemic manifestations of infection, that is, fever, malaise, swelling and pain. Such patients should be treated surgically as early as possible.

1) Treatment of abscess: Acute dentoalveolar cellulitis and abscess usually require antibiotic therapy. Insulin is usually the drug of choice. Adjective treatment should include endodontic therapy or extraction of the causative tooth and surgical drainage of any areas of pus accumulation. The patient must be monitored carefully to determine the response to this therapy. Conversely many chronic dental abscess need no antibiotic therapy. The patient often has no temperature, little induration and malaise. Treatment may be entirely surgical without antibiotic therapy.

2) Treatment of pericoronitis: The bacteria responsible for the pericoronitis are all anaerobic bacteria. Debridement by irrigation and possible extraction of the offending or opposing tooth usually are sufficient therapy without requirement of use of antibiotics. However if the patient has clearly established infection with temperature elevation and sufficient trismus to prevent adequate local therapy then use of antibiotics may be necessary for several days before surgery can perform. Again penicillin is the drug of choice.

3) Treatment of osteomyelitis: although infection of the gas usually requires surgical intervention antibiotic therapy is also essential for successful treatment. Special care must be taken to identify the causative organisms using anaerobic and aerobic culture of tissue removed at surgery for appropriate antibiotic therapy. Osteomyelitis must be treated with antibiotics for a much longer period then soft tissue infections.

4) Management of maxillofacial fractures: administration of the antibiotics should begin as early as possible after diagnosis of fracture to diminish the chance of clinical infection. All fractures through tooth bearing bone should be considered compound because they communicate with the oral cavity through the socket and antibiotics must be given accordingly. Insulin is the drug of choice for facial fractures. The patient who assistant facial fractures must be given antibiotics according to the therapeutic principles.

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