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Research Article

PROPHYLACTIC USE OF ANTIBIOTICS IN ORAL AND MAXILLOFACIAL SURGERY–A REVIEW OF CURRENT CONCEPTS

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A B S T R A C T

Antibiotic prophylaxis in oral and maxillofacial surgery aims the prevention of the infection of the surgical wound, either due to the characteristics of the surgery or the general state of the patient. This risk increases with the contamination of the surgical operation area, making it necessary to imply a prophylactic treatment of the infection in clean-contaminated and contaminated surgeries and treatment of the infection in dirty surgeries. Moreover, a proper surgical technique helps to reduce the development of the postsurgical infection. The most important decision for the dental practitioner to make is not only which antibiotic to use but whether to use one at all. This article will discuss important factors to be kept in mind while prescribing antibiotics in dentistry.

INTRODUCTION

Infection is the outcome of invasion and multiplication of microorganisms such as bacteria, viruses and parasites. Infection may be asymptomatic or symptomatic, clinically apparent sign may also be seen. Humans are subjected to various mild, moderate or severe infections.

Penicillin was first antibiotic and was used clinically in 1940. However, the use of antibiotics could not end wound infections due to antibiotic resistant bacteria and new surgical interventions has risen in past decades. The use of systemic antibiotics, drainage and surgical excision of affected tissue are primary methods of wound management.[1]

In dentistry, the discovery of penicillin was believed to be used in most odontogenic infections as it is caused by penicillin sensitive organisms. In dentoalveolar surgery, particularly in the removal of infected or impacted third molars the antibiotics are prescribed prophylactically.[2,3]

Prophylactic antibiotics are generally administered both preoperatively and postoperatively. The empiric use of antibiotic prophylaxis for dental procedures, especially those that cause bleeding in the mouth has become a reasonably well-established practice among dental professionals.[4,5]

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The principles of use of the antibiotics are basically same for maxillofacial surgery or anywhere in the human body.

Classification

Although there are several classification for antibiotics, based on bacterial spectrum (broad versus narrow) or type of activity (bactericidal vs. bacteriostatic). The most useful is based on chemical structure. Antibiotics within a structural class will generally have similar patterns of effectiveness, toxicity, and allergic potential.[6,7]

According to their mechanism of action, antibiotics are classified as (Table 1)

Table 1 Classification of antibiotics

Inhibit cell wall synthesis:	Penicillin, Cephalosporins, Cycloserine, Vancomycin, Bacitracin
Cause leakage from cell membranes	Polypeptides-Polymyxins, Colistin, Bacitracin Polyenes-Amphotericin B, Nystatin, Hamycin
Inhibit protein synthesis	Tetracycline, Chloramphenicol, Erythromycin, Clindamycin, Linezolid
Cause misreading of m-RNA code and affect permeability	Aminoglycosides- Streptomycin, Gentamicin
Inhibit DNA gyrase	Fluoroquinolones, Ciprofloxacin
Interfere with DNA function	Rifampin, Metronidazole
Interfere with DNA synthesis	Acyclovir, Zidovudine
Interfere with intermediary metabolism	Sulfonamides, Sulfones, Trimethoprim, Pyrimethamine, Ethambutol

Indications

Antibiotics are rather adjunct than an alternative to dental interventiont. Antibiotics are indicated when clinical signs of involvement are apparently evident. The major use of antibiotic prophylaxis for dental procedures are as follows:

Odontogenic infections

Penicillin is the drug of choice in treating orofacial and odontogenic infections as it is more prone to gram positive aerobes and intraoral anaerobes. The micro-organisms found in both alveolar abscess, periodontal abscess and necrotic pulps. Both aerobic and anaerobic microorganisms are susceptible to penicillin.[8] The penicillin followed by the cephalosporins and tetracyclines are most frequently implicated in these reactions. Macrolides such as 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.[9] Ciprofloxacin, a fluoroquinolone, is the commonly used drug for endodontic infections.

Non-odontogenic infections

Fluoroquinolones are indicated for bone and joint infections, genitourinary tract infections, and respiratory tract infections.[10] 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.[11] Bone and anaerobic infections are managed orally by clindamycin and parenterally by lincomycin.

Infective endocarditis

Infective endocarditis is uncommon but serious and often life threatening condition. The pathogenesis of infective endocarditis comprises of a complex sequence of events.[12] Anatomic localization of infection is determined by the adherence of microorganisms to various sites.[13] The standard regimen includes high doses of amoxicillin in children and adults to be taken one hour before the dental treatment. 2 g of oral amoxicillin should be given to adults before the dental procedure commencement.[14] Dajani *et al* have reported that 2 g of amoxicillin provides several hours of antibiotic coverage.[15] Clindamycin is drug of choice in patients allergic to beta-lactamics and achieved best results in the odontogenic infections treatment.[16,17]First generation ceplalosporin are recommended in the cases allergic to amoxicillin or penicillin. In prosthetic heart valves, Vancomycin and streptomycin are used prophylactically for prevention of subacute bacterial endocarditis (SABE).

Local infection

The various routine surgical procedures covered by systemic antibiotics includeimpacted third molars, implant surgery, periapical surgery, benign tumour surgery. Medical conditions as in immunocompromised patients represent a special division for dental professionals as they are more prone to bacteraemiarapidly leading into septicaemia.[18] Invasive dental procedure like dental extraction, deep periodontal scaling should be avoided whenever feasible.[19] 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, periapical tooth surgery, intraligamentary injections and gingival surgery. Antibiotic coverage is also essential for uncontrolled diabetic patients.[20]Dental surgeon plays a vital role in treating medically compromised patients who undergo dental treatment. Early detection of diabetes rules out during the treatment period and prognosis.[21]

Uses of Antibiotics in Oral and Maxillofacial Surgery

Antibiotics are mainly divided into two types:[22]

1. Bactericidal and Bacteriostatic Antibiotics
2. Broad-spectrum and Narrow-spectrum Antibiotics

Bactericidal and Bacteriostatic Antibiotics

Some antibiotics are bactericidal, meaning that they work by killing bacteria. Other antibiotics are bacteriostatic, meaning that they work by inhibiting the division or multiplication of bacteria.

Each different type of antibiotic affects different bacteria in different ways. For example, an antibiotic might inhibit a bacterium's ability to turn glucose into energy, or its ability to construct its cell wall. When this happens, the bacterium dies instead of reproducing.[22]

Broad-spectrum and Narrow-spectrum Antibiotics

Some antibiotics can be used to treat a wide range of infections and are known as broad-spectrum antibiotics. Others are only effective against a few or specific types of bacteria and are called narrow-spectrum antibiotics.[22]

Oral Minor Surgery

In healthy patients, most of the procedures in the oral cavity need no antibiotic prophylaxis because of low infection rate. [23] These cases include impacted third molars.[24]

Road side Trauma

Development of infection in road traffic accident or trauma patients have 5 times more higher mortality as opposed to those without any infection. Across the globe more than 80% of the late deaths in the adult trauma patients are due to septicemia. The huge challenge in controlling wound infections is because of multiple antimicrobial resistance to antibiotics and also the high rate of infections caused by the methicillin-resistant Staphylococcus aureus and polymicrobial flora.[25]

Orthognatic Surgery and Preprosthetic Surgery

They are considered clean-contaminated surgeries. There is a higher incidence in infections in bimaxillary surgery without proper oral or parental antibiotic (like cephalosporin) regime.[26]

Salivary Glands

In surgeries such as parotidectomy or submaxilectomy does not always require antibiotic prophylaxis.[27]

Oncological, Reconstructive and Cervical Surgery

It has been demonstrated that the use of preoperative antibiotics reduces the incidence of postoperative infections. As in cervical pathology and oncological surgery, antibiotic prophylaxis classes that can be used are clindamycin combinated with cefazolin, cephalosporins, aminoglycosides, chinolones or penicillin derivates combinated with betalactamase inhibitors.[28]

Ludwig's Angina

Ludwig's angina and deep neck infections are dangerous and can be fatal because of their normal tendency to cause edema, distortion and engorgement of tracheal airway which may arise as a consequence of airway management mishaps. In the early stages of the disease, patients can be managed with observation and intravenous antibiotics. Advanced infections require the airway to be secured with surgical drainage or tracheostomy. This is complicated by trismus, airway edema, and tongue displacement.[27, 28]

Intravenous penicillin G, clindamycin or metronidazole are the antibiotics recommended for use prior to obtaining bacterial culture and antibiogram results. Gentamycin is also recommended with the above drug association.[29,30]

Use of Antibiotics in Animal Bites

After being bitten by an animal or human, it is important to quickly and carefully clean the wound thoroughly with soap and a large amount of water; this can help to prevent infection. If there is bleeding, a clean towel or gauze should be pressed to the wound to slow or stop the bleeding.

Types of Animal bites

The location and type of the injury depends upon the animal inflicting the bite.

a. Dog bites
b. Cat bites
c. Rodent bites
d. Human bites
e. Other types of bites — such as squirrels, rabbits, and guinea pigs, are generally treated the same way as cat bites.

Antibiotic prophylaxis should be considered for all bites requiring closure and for high-risk bites. All cat bites are considered high risk for infection because they tend to cause deep puncture wounds.[31]

Amoxicillin/clavulanate is generally considered the first-line prophylactic treatment for animal bites. A three-day to seven-day course of prophylactic antibiotics is likely adequate.[32,33]

Use of antibiotics in Human bite

There are no clear guidelines for the initiation of antibiotic prophylaxis after a human bite. There are only two randomized clinical trials to date to study the advantage of prophylactic antibiotics in human bite injuries. In the earlier trial, patients with bites on the hand (bites involving joints or tendons were excluded) were randomized to either a placebo, an oral cephalosporin or a combination of parenteral cephalosporin and penicillin.[34]

Antibiotics in Hospital Borne Infections

Hospital-acquired infection also known as nosocomial infection is an infection that is contracted from the environment or staff of a healthcare facility. It can be spread in the hospital environment, nursing home environment, rehabilitation facility, clinic, or other clinical settings. Infection is spread to the susceptible patient in the clinical setting by a number of means. Nosocomial infections can cause severe pneumonia and infections of the urinary tract, bloodstream and other parts of the body. Many types are difficult to treat with antibiotics. In addition, antibiotic resistance can complicate treatment.[35]

Antibiotic Resistance

Antibiotics are extremely important in medicine, but unfortunately bacteria are capable of developing resistance to them. Antibiotic-resistant bacteria are germs that are not killed by commonly used antibiotics. When bacteria are exposed to the same antibiotics over and over, the bacteria can change and are no longer affected by the drug.

MRSA (***methicillin-resistant staphylococcus aureus***), is a form of bacterial infection that is resistant to numerous antibiotics including methicillin, amoxicillin, penicillin and oxacillin, thus making it challenging to treat the infection successfully.

"Methicillin" represents the semisynthetic penicillin-related antibiotic once effective against *staphylococci* (*staph*). *Staph* bacteria have developed a resistance to penicillin-related antibiotics, including methicillin - these resistant bacteria are called *methicillin-resistant staphylococcus aureus*(MRSA).[36]

Treatment includes

i. Vancomycin
ii. Clindamycin
iii. Tetracycline drugs - Doxycycline and Minocycline
iv. Trimethoprim and Sulfamethoxazole
v. Rifampin
vi. Linezolid.

Newer Antibiotics

The incidence of antimicrobial resistance has continued to rise with a threat to return to the "pre-antibiotic" era. This has included a sharp increase in multi-drug resistant organisms, which may cause life-threatening infections. Efforts have been made to develop new antibiotics with novel modes of action, aimed at acting against these multi-drug resistant strains.[37]This review aims to focus on newly available and investigational antibiotics targeting gram positive organisms. It is likely that these antibiotics will be used mainly in a secondary care setting; however primary care health care professionals also need to have an understanding of these antibiotics, since patients may be discharged home on them.[38]

1. Glycopeptides- Vancomycin, Tecoplanin
2. Lipopeptide - Daptomycin
3. Polypeptide - Bacitracin
4. Fosfomycin - A Phosphonic Acid Derivative
5. Cycloserine -An Analogue Of D-Alanine
6. Oxazolidinones - Linezolid, Radezolid, Torezolid
7. Streptogramins - Pristinamycin
8. Polymyxin-B and Colistin
9. Mupirocin
10. Fusidic Acid
11. Meropenem
12. Cefepime

CONCLUSION

Antibiotics should not be used as a substitute for needed surgical treatment, inadequate therapies or fear ofunknown. Remember, Infections are cured by the host not by the antibiotics. Never use combinations blindly in the hope that "if one is good, two is better and three could cure almost any infections."

Antibiotic therapy is an art and a science. There are so many confounding variables, such as suspected pathogen, ability to establish drainage, pharmacokinetic properties of the drug, mechanism of action of the antibiotic, virulence of the infection, the current health status of the host, and host defense mechanisms, that it is not possible to make antibiotic therapy into a mechanistic technologic science.[39] It is important to emphasise that surgical antibiotic prophylaxis is an adjunct to and not a substitute for good surgical technique. Antibiotic prophylaxis should be regarded as one component of an effective policy for control of hospital-acquired infection.The most important decision for the dental practitioner to make is not only which antibiotic to use but whether to use one at all.

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