Antibiotics Use in Dental Practice: A Review

Basanta Kumar Choudhury[1], Suvranita Jena[2], Sanat Kumar Bhuyan[3], Rajat Panigrahi[4], Abhishek Ranjan Pati[4], Rupsa Dash[2], Santosh Subudhi[7]

[1]Assistant Professor, [2]Post Graduate Trainee, [3]Professor, [4]Associate Professor, Department of Oral Medicine & Radiology, [7]Professor, Department of Oral Surgery, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar 751003, Odisha, India

Abstract

In dentistry, indications of antibiotics are determined by multiple clinical and bacteriological epidemiological factors. Treating odontogenic and non-odontogenic infections, for local infections, anti-microbial coverage is recommended. These act as an adjunct to dental treatment. The paper reviews the indications, usage, dosage of antibiotics, precautionary measures to be taken while prescribing them.

Keywords: *Antibiotics, Dentistry, Indications, Dosage.*

Introduction

In the year 1929, antibiotics were discovered by the "Scottish bacteriologist Alexander Fleming" while working in a teaching hospital in London on anti-bacterial action of the Penicillium species. In the 20th century, antimicrobialsare considered as theutmost contribution. The word "Antibiotics" is derived from the word "Antibiosis". This term was coined by Louis Pasteur in the year 1889 which suggests that life could be used to eliminate life. These are nowadays considered as a wonder drug in dental practice for numerous issues like periodontal, mucosal infections, etc. These are used both for treatment as well as prevention of the infections. According to studies, "Dentists prescribe between 7% and 11% of all most common antibiotics such as– metronidazole, tetracycline, beta-lactam, macrolides, clindamycin, etc." These are also associated with multiple unfavourable side effects like gastrointestinal issues to anaphylactic shock. Here in this review, we will be discussing the role, dosage, usage, indications associated with antibiotics in the field of dentistry.[1]

Corresponding Author:
Suvranita Jena
Post Graduate Trainee, Department of Oral Medicine & Radiology, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar 751003, Odisha, India
e-mail: suvranitajena9@gmail.com

Classification[2]:

"According to the mode of action, classified as follows:

1. Antimetabolite action – Sulphonamide, Trimethoprim
2. Cell wall inhibitor – Penicillin, Cephalosporins, Vancomycin
3. DNA gyrase inhibitor – Ciprofloxacin, Ofloxacin, Nalidixic Acid
4. Bacterial protein synthesis inhibitor – Tetracycline, Clindamycin, Aminoglycoside."

An ideal antibiotic should be bactericidal rather than bacteriostatic, should be selectively toxic to the microbes and spare eukaryotic cells. It should be soluble and remain active for a long duration to be effective enough. It should not create host resistance and allergies in the host It should be safe for the gut microflora during a long-term prophylactic usage. There should be minimal drug interactions recorded for an ideal antibiotic.

Particularities of Antibiotics Use in Dentistry: Clinician's antibiotic prescriptions are empirical as the microorganism responsible for the infections such as pus

or exudate is not known. Abroad range of microorganisms are encountered in the oral cavity; a broad-spectrum antibiotic is typically prescribed. Sometimes two or more combinations of antibiotics are prescribed due to the increasing antibiotics resistance among bacteria.[2]

Antibiotics Indications: Antibiotics are considered as an adjunct to numerous dental procedures. They are used in treating immune-compromised patients, systemic infections and rapidly progressing infections.

1. **Antibiotics used for odontogenic infection:** "Penicillin" is the drug of choice as it is susceptible to gram-positive aerobes and anaerobes which are found in periodontal & gingival abscess and pulpal necrosis. Clavulanic acid in combination with penicillin acts miraculously for infections caused by "Streptococcus, Pneumococci and Streptococci." Clindamycin 300 mg is preferred drug for patients with penicillin allergy followed by "Azithromycin" and "Metronidazole", for delayed type of hypersensitivity reactions caused by penicillin, Cephalosporins are advisable. Tetracycline is most effective in cases of acute necrotizing ulcerative gingivitis as these are considered bacteriostatic antibiotics that obstruct the binding of aminoacyl-t- RNA synthetase to ribosome acceptor site. In 3% - 5% of the population, the side effects noted by the use of penicillin are hypersensitivity reactions. Cephalosporin and tetracycline are also considered to have hypersensitivity reactions after penicillin.

   In endodontic infections, azithromycin showed excellent pharmacokinetics. "A loading dose of 500 mg followed by 250 mg once daily for a week should be followed".[6] Ciprofloxacin has also shown positive results in treating endodontic infections. Against anaerobes, metronidazole, a synthetic anti-microbialagent is considered effective. With "a loading dose of 1000 mg followed by 500 mg six hourly for a week is recommended". However, for odontogenic infections, beta-lactam antibiotic is always recommended.[6]

2. **Antibiotics for non-odontogenic infections:** As these infections require prolonged treatment, a newer synthetic antibiotic namely fluoroquinolones are used for management. It is a broad-spectrum antibiotic and restricts bacterial DNA replications. It is indicated for "bone and joint infections, genitourinary infections and respiratory infections". Chronic infections like tuberculosis require long-duration antibiotic prescriptions such as – "Rifampicin, Ethambutol, Isoniazid, etc. Penicillin G Benzathine is effective in the treatment of syphilis.

3. **Antibiotic prophylaxis in preventing infective endocarditis:** Standard regimen for children and adult include high doses of amoxicillin one hour before any dental procedures. An effective dose is considered as 2 g of amoxicillin for adult patients before any dental procedures.[6] First-generation cephalosporinsare recommended for patients having an allergy to penicillin or amoxicillin. Patients having prosthetic heart valve, "Vancomycin & Streptomycin" are prescribed for the prevention of infective endocarditis. Negligence of the antibiotic prophylaxis during the dental procedure may lead to subacute bacterial endocarditis.

4. **Antibiotics in treating local infections:** Surgical procedures such as an impacted third molar, implant placement, orthognathic surgery, benign tumor surgery etc are regularly covered with systemic antimicrobials. Studies reveal postoperative pain after third molar surgery has reduced with antibiotic prophylaxis. Abu-Taa et al reported a marked reduction in the post-operative discomfort as he compared "the benefits of pre and post-operative antibiotics prophylaxis in the third molar surgery."[8]

Danda et al documented clinically significant results when he evaluated "the prophylactic value of single-dose antibiotic prophylaxis to single day antibiotics for postoperative infection in patients undergoing orthognathic surgery".[9] Numerous studies reported a significant reduction in implant failure under appropriate antibiotic prophylaxis. Rizzo et al reported an efficient reduction in post-operative infections after analyzing five hundred twenty-one dental endo osseous implants, those were placed under antibiotic coverage.[10] But on the contrary, "Gynther et al revealed that there was no significant difference noted after dental implant placement without any antibiotic coverage for the patient".[11] On the other hand, Nabeel Ahmad et al conducted a literature review. He reviewed the effects of antibiotics among eleven thousand four hundred and six endo osseous implants and reported fairly no significant advantage from the use of antibiotic prophylaxis during the placement of implants.[12] So, the use of antibiotics in implant surgery remains controversial. But during periodontal surgery, the use of antibioticsis compulsory as the surgical site is often contaminated with microorganisms.

Immune compromised patients are more prone to bacteraemia which further leads to septicaemia.[13] The dental procedures should always be performed under antimicrobials coverage. For patients with uncontrolled diabetes mellitus, antibiotic coverage is mandatory before any invasive dental surgery to avoid any infections. Not all patients with joint replacement surgery are recommended for antibiotic prophylaxis but patients with increased risk of blood bornehaematogenous infections associated with the prosthetic joints are advised to be under antibiotic coverage undergoing dental procedures.[14]

Precaution During Antibiotic Usage: Patients with renal failure should be treated with the utmost precautions as most of the antibiotics are excreted through the kidney. It is advised for a reduction in drug dosage to avoid toxicity due to elevated plasma drug concentrations. Modifications can be made in the drug administration interval without modifying the amount of drugs. For patients having creatinine clearance 10-50 ml/min, amoxicillin and clavulanate is prescribed 500-875 mg/8 hours, and if the patient is having creatinine clearance <10 mg/min, it is prescribed with similar dose in every 12-14 hours. There is no adjustment needed when prescribing Clindamycin (300 mg/8 hours), Doxycycline (100 mg/24 hours), Erythromycin (250-500 mg/6 hours), Azithromycin (500 mg/24 hours). For patients having creatinine clearance 10-50 ml/min, metronidazole is prescribed 250-500 mg/8 hours, and if the patient is having creatinine clearance <10 mg/min, it is prescribed with similar dose in every 8-12 hours. In a study, Gudapati et al documented that the dosage of indomethacin. Naproxen, ibuprofen should be reduced for advanced stages of renal failure. [17]

In patients with liver failure, the use of the antibiotic should be restricted to avoid toxicity as the antimicrobials are metabolized in the liver and are eliminated in the bile. Some antibiotics such as erythromycin, clindamycin, metronidazole are advised to administer to the patients with dosage modifications.[16] In a study conducted by Douglas et al, it is strictly contraindicated to use tetracycline and antitubercular drugs in patients with liver failure.[18]

In pregnancy, due to increased teratogenic effects on the fetus, usage of tetracyclines and aminoglycosides is contraindicated. In a study, "Shrout et al focused on the need for antibiotic prophylaxis for pregnant patients as it eliminates the bacterial loads' od periodontal pathogens".[20] During pregnancy, drugs like "cephalosporin, azithromycin, penicillin with or without beta-lactamase inhibitors" are given with utmost caution. Benzodiazepines possess a risk of oral cleft development during initial months of pregnancy according to Haas et al.[21] Gestational use of "Naproxen, Diclofenac, Ibuprofen" alone or in combination is associated with spontaneous abortion.

Principles For Choosing Appropriate Antibiotics: The following are principles to be followed for prescribing appropriate antibiotics to the patient. Starting from "proper identification of the microorganisms, determining of antibiotic sensitivity, use of narrow-spectrum antibiotics with minimal toxicity after obtaining proper drug history and use of bactericidal antimicrobials over bacteriostatic ones are few cardinal principles to be followed by clinicians.

Conclusion

In dentistry as well as in the medical field, antibiotic therapy is considered mandatory. Penicillin is still the gold standard drug in treating various dental infections. As mentioned above, patients at high risk such as endocarditis, pregnant women, immunocompromised individuals should consult clinicians and specialists before undergoing any dental treatments.

Conflict of Interests: None

Ethical Permission: Approved

Funding: Nil

References

1. Poveda-Roda R, Bagán JV, Sanchis-Bielsa JM, Carbonell-Pastor E. Antibiotic use in dental practice. A review. Med Oral Patol Oral Cir Bucal 2007;12: E186-92
2. Shivanand S et al The Current Concepts in the Use of Antibiotics in Dental Practice.International J AppEngineer Res 2019; 13(5): 2959-2964
3. Ramasamy A. A review of the use of antibiotics in dentistry and recommendations for rational antibiotic usage by dentists.IntArabJAntimicrobAgent 2014; 4(2): 1.
4. JayakaranG Et al.Antibiotics and its use in pediatric dentistry: A review. IntJ Appl Dental Sciences 2018; 4(2): 310-314
5. Sweeney LC, Dave J, Chambers PA, Heritage J.

Antibiotic resistance in general dental practice-a cause for concern? J Antimicrob Chemother. 2004;53(4):567–576.

6. Ramu C, Padmanabhan TV. Indications of antibiotic prophylaxis in dental practice- review. Asian Pac J Trop Biomed. 2012;2(9):749–754.
7. Dar-Odeh NS, Abu-Hammad OA, Al-Omiri MK, Khraisat AS, Shehabi AA. Antibiotic prescribing practices by dentists: a review. TherClin Risk Manag. 2010; 6:301–306
8. Abu-Ta'a M, Quirynen M, Teughels W, van Steenberghe D. Asepsis during periodontal surgery involving oral implants and the usefulness of peri-operative antibiotics: a prospective, randomized, controlled clinical trial. J Clin Periodontol. 2008;35(1):58–63.
9. Danda AK, Wahab A, Narayanan V, Siddareddi A. single dose versus single day antibiotic prophylaxis for orthognathic surgery: a prospective randomized, double blind clinical studt. J Oral Maxillofacial Surg. 2010;68(2):344–346.
10. Rizzo S, Zampeth P, Rodriquez Y, Baena R, Svanosio P, Lupi SM. Retrospective analysis of 521 endosseus implant placed under antibiotic propylaxis and review of literature. Minerva Stomatol. 2010;59(3):75–88.
11. Gynther GW, Kondell PA, Moberg LE, Hemimdahl A. Dental implant installation without antibiotic prophylaxis. Oral Surg Oral Med Oral Pathol. 1998; 85:509–511
12. Ahmad N, Saad N. Effects of antibiotics on dental implants. J Clin Med Res. 2012;4(1):1–6.
13. Pallasch TJ, Slots J. Antibiotic prophylaxis and the medically compromised patient. Periodontology. 1996; 10:107–138.
14. Advisory statement. Antibiotic prophylaxis for dental patients with total joint replacements. J Am Dent Assoc. 1997; 128:1004–1008.
15. Livornese LL Jr, Slavin D, Gilbert B, Robbins P, Santoro J. Use of antibacterial agents in renal failure. Infect Dis Clin North Am. 2004;18(3):551–ix.
16. Douglas LR, Douglas JB, Sieck JO, Smith PJ. Oral management of the patient with end-stage liver disease and liver transplant patient. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998; 86:55–64.
17. Gudapati A, Ahmed P, Rada R. Dental management of patients with renal failure. Gen Dent. 2002;50(6):508–510.
18. Ong JP, Oehler G, Krüger-Jansen C, Lambert-Baumann J, Younossi ZM. Oral L-Ornithine-L-aspartate improves health-related quality of life in cirrhotic patients with hepatic encephalopathy: an open-label, prospective, multicentre observational study. Clin Drug Investig. 2011;31(4):213–220.
19. Shrout MK, Comer RW, Powell BJ, McCoy BP. Treating the pregnant dental patient: Four basic rules addressed. J Am Dent Assoc. 1992;123(5):75–80.
20. Haas DA, Pynn BR, Sands TD. Drug use for the pregnant and lactating patient. Gen Dent. 2000;48(1):54–60
21. Sanz M, Herrera D. Antibiotic and antimicrobial use in dental practice, Individual drugs. In: Newman MG, Vanwinkelhoff AJ,Chicago: Quintessence; 2001. pp. 33-52
22. Swift JQ, Gulden WS. Antibiotic therapy managing odontogenic infections. Dent Clin North America. 2002; 46:623–633.