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Antibiotics and Antimicrobial Therapies in Periodontics

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ABSTRACT

Periodontal diseases, like chronic and aggressive periodontitis, caused by subgingival bacterial biofilms, affect oral health and overall well-being. Treatment strategies, including scaling and root planing (SRP), aim to ameliorate periodontal pathogens and enhance clinical outcomes. While SRP is effective, it may fall short in severe cases with deep pockets. Systemic antibiotics like amoxicillin and doxycycline have demonstrated utility but raise concerns about antibiotic resistance. Localized drug delivery systems and antimicrobial mouthwashes provide alternatives to control pathogens without systemic effects. Personalized, evidence-based approaches are vital, and monitoring antibiotic resistance trends is crucial in this evolving field. By judiciously combining treatment modalities, we can significantly improve periodontal health and halt disease progression in those with periodontitis.

Keywords: Systemic antibiotics, Antimicrobial therapies, Periodontitis, local drug delivery, antibiotic Resistence.

1. INTRODUCTION

Periodontitis, an infectious and inflammatory disease, arises from an imbalance in the subgingival microbiota. Effective treatment strategies aim to reduce the prevalence of periodontal pathogens and promote a healthier microbial community on tooth surfaces. This approach not only improves clinical outcomes but also prevents further disease progression. [1]The human oral cavity harbors around 700 different types of microorganisms, most of which are harmless. Periodontitis is a common dental condition that leads to the deterioration of tooth-supporting structures. The term "periodontitis" stems from "periodont," referring to the structures surrounding the teeth, and "itis," indicating inflammation. Initially affecting the gums, periodontitis can progress deeper, affecting bone health and causing tooth loss if left untreated. [2]Periodontal diseases, like chronic and aggressive periodontitis, caused by subgingival bacterial biofilms, affect oral health and overall well-being. Treatment strategies, including scaling and root planing (SRP), aim to ameliorate periodontal pathogens and enhance clinical outcomes. While SRP is effective, it may fall short in severe cases with deep pockets. [3] Systemic antibiotics like amoxicillin and doxycycline have demonstrated utility but raise concerns about antibiotic resistance. Localized drug delivery systems and antimicrobial mouthwashes provide alternatives to control pathogens without systemic effects. Personalized, evidence-based approaches are vital, and monitoring antibiotic resistance trends is crucial in this evolving field. By judiciously combining treatment modalities, we can significantly improve periodontal health and reduce disease progression in those with periodontitis. [4]

2. ANTIBIOTIC THERAPY FOR PERIODONTAL DISEASES: A COMPREHENSIVE GUIDE

2.1. CHRONIC PERIDONTITIS:

Antibiotics are typically prescribed for patients experiencing worsening chronic periodontitis despite traditional mechanical treatments. This includes individuals with refractory periodontitis or recurrent disease who do not respond well to standard periodontal therapy. Commonly used antibiotics in such cases include Tetracycline, Doxycycline, Metronidazole, Clindamycin, Amoxicillin + Clavulanic Acid (Augmentin), Azithromycin, Metronidazole + Amoxicillin, and Spiramycin. [5]

2.2. AGGRESSIVE PERIODONTICS:

Localized aggressive periodontitis (LAP), often associated with Aggregatibacter actinomycetemcomitans, can be effectively controlled or eliminated through systemic therapy using a combination of metronidazole and amoxicillin. Other recommended antibiotics for both localized and generalized aggressive periodontitis include Tetracycline, Doxycycline, Minocycline, Metronidazole, Amoxicillin + Clavulanic Acid (Augmentin), and Metronidazole + Amoxicillin.[6]

2.3. NECROTIZING PERIODONTAL DISEASES:

Patients with moderate or severe necrotizing ulcerative gingivitis (NUG) or necrotizing ulcerative periodontitis (NUP), accompanied by local lymph node swelling and systemic symptoms, may require antibiotic treatment. Recommended antibiotics in these cases include amoxicillin, metronidazole, and a combination of amoxicillin and metronidazole. [7]

2.4. PERIODONTAL ABSCESS:

Antibiotic therapy is necessary for periodontal abscesses with systemic symptoms like fever, malaise, and swollen lymph nodes. However, antibiotics should be used in conjunction with surgical incision and drainage as part of the comprehensive treatment plan. [8]

The typical antibiotic regimens employed for the treatment of

2.5. Single Agent

Amoxicillin: Administer 500 mg three times a day for a duration of 8 days. Azithromycin: Take 500 mg once daily for a period ranging from 3 to 7 days. Ciprofloxacin: Consume 500 mg twice daily over an 8-day course. Clindamycin: Take 300 mg three times a day, spanning 10 days. Doxycycline: Administer 100–200 mg once daily, continuing for 21 days. Metronidazole: Consume 500 mg three times a day for 8 days.

2.6. Combination Therapy:

Amoxicillin-metronidazole: This combination involves taking 250 mg of amoxicillin and 375 mg of metronidazole thrice daily, lasting for 8 days. It stands out as the most frequently utilized antibiotic combination in the field of periodontics. Ciprofloxacin-metronidazole: This combination comprises 500 mg of each antibiotic, taken twice daily throughout 8 days.

3. SYSTEMIC ANTIBIOTICS

3.1. PENICILLINS are often prescribed with a common strategy that entails the administration of amoxicillin in conjunction with a beta-lactamase inhibitor such as clavulanic acid. Augmentin, a medication incorporating this amalgamation, proves advantageous in treating patients with refractory or localized aggressive periodontitis. In the context of guided tissue regeneration (GTR), systemic therapy utilizing amoxicillin-clavulanic acid has been utilized to suppress periodontal pathogens and promote clinical attachment gains, particularly in cases of aggressive periodontitis. Metronidazole is a bactericidal antibiotic that targets anaerobic microorganisms by inhibiting nucleic acid synthesis without disrupting the protective aerobic microbiota. It is commonly prescribed at dosages of 200 or 400 mg every 8 hours and can interact with alcohol, disulfiram, warfarin, and hydantoin anticonvulsants. Severe side effects may occur in some patients, such as seizures, numbness, or tingling in the limbs. [9]

3.2. TETRACYCLINE in Host modulatory therapy aims to restore the balance between proinflammatory and anti-inflammatory mediators, mitigating periodontal disease progression. **Chemically modified tetracycline's (CMTs)** are designed to improve certain properties, such as reducing antimicrobial activity while enhancing anti-inflammatory and host-modulating effects.

Subantimicrobial dose doxycycline (SDD) is a therapeutic approach involving the use of doxycycline at doses lower than those typically employed for its antibiotic properties. SDD is considered a host-modulating agent, meaning it influences the host's response to inflammation. It may help regulate the balance between pro-inflammatory and anti-inflammatory mediators, contributing to a more controlled immune response. A commercially accessible product known as 'Periostat' is recommended for use at a dosage of 20mg twice daily over a period of 6 to 9 months to achieve the desired modulatory effect on the host. [10]

3.2. AZITHROMYCIN is categorized as a bacteriostatic antibiotic with effectiveness against gram-negative pathogens. It is regarded as the safest among macrolides. Typically, it is recommended as an alternative for patients allergic to penicillin. The prescribed dosage is 500 mg once daily for three days in therapeutic cases, or 500 mg one hour before dental procedures for prophylaxis. Common side effects associated with azithromycin include nausea, diarrhea, and gastrointestinal disorders. [11]

3.3. ERYTHROMYCIN is a bacteriostatic antibiotic commonly prescribed for conditions such as dental caries and dental plaque, mainly targeting Streptococcus mutans. It can inhibit dental caries and reduce the growth of dental plaque. Dosages typically range from 250 mg to 500 mg every 6 hours. However, its use is not preferred due to potential gastrointestinal problems, hepatotoxicity, bacterial resistance, and contraindications with simvastatin. [12]

3.4. CLARITHROMYCIN is characterized as a broad-spectrum antibiotic, often viewed as an advanced iteration of erythromycin, demonstrating strong activity against anaerobic Gram-positive bacilli. It is a viable option for controlling pulp and periodontal infections, and the standard prophylactic dose is typically 500 mg administered orally one hour before dental procedures. However, it is essential to note that potential side effects may include gastrointestinal issues such as nausea and diarrhea.

3.5. CEPHALOSPORINS, a class of beta-lactam antibiotics, operates by inhibiting the formation of bacterial cell walls. They are effective against aerobic bacteria and, when used in conjunction with metronidazole, can address both aerobic and anaerobic bacterial infections. Commonly prescribed first-generation cephalosporin in dental practice includes cephalexin and cefazolin.

3.6. CEPHALEXIN can be recommended for patients allergic to penicillin, with a suggested dosage of 2 grams taken orally one hour before dental procedures. It is available in various strengths, including 250mg, 500mg, and 750mg, with a half-life (T 1/2) of approximately 1 hour.

3.7.CEFAZOLIN is recommended for patients allergic to penicillin who cannot take medications orally. The suggested dosage is 1 gram administered intravenously (IV) or intramuscularly (IM) 30 minutes before the procedure. It's important to note that patients treated with cephalosporins may have an increased risk of Candida albicans and yeast colonization.

3.8.CLINDAMYCIN, a broad-spectrum bacteriostatic antibiotic effective against both aerobic and anaerobic pathogens, is preferred in cases of persistent infections, offering greater efficacy compared to penicillin and metronidazole. Common dosages are 600 mg or 300 mg every 8 hours, orally or intravenously. Side effects may include vomiting, nausea, diarrhea, skin rash, jaundice, hepatitis, blood cell count changes, and pseudomembranous colitis. Studies have demonstrated clinical attachment gains and reduced disease activity with adjunctive clindamycin therapy in periodontal patients.

3.9.CIPROFLOXACIN, a second-generation fluoroquinolone antibiotic, is effective against both gram-positive and gram-negative bacteria with minimal side effects. It is commonly prescribed orally at 500 mg every 12 hours for odontogenic infections. Frequently observed adverse effects encompass gastrointestinal problems such as nausea, vomiting, and diarrhea. Dental practitioners should exercise caution when patients have a history of using theophylline, as the interaction can have severe consequences.

3.10.MOXIFLOXACIN, a fourth-generation fluoroquinolone with broad-spectrum bactericidal activity against aerobic, anaerobic, Gram-positive, and Gram-negative bacteria, can be effective in treating odontogenic and periodontal infections due to its ability to penetrate periodontal and bone tissues. The recommended dose for odontogenic infections is 400 mg once daily. However, caution is advised in pregnant individuals due to potential effects on cartilage maturation. [12]

4. LOCAL DRUG DELIVERY FOR PERIODONTAL DISEASES

Local drug delivery has emerged as a promising approach for the treatment of periodontal diseases, offering several advantages over systemic therapy, such as reduced systemic side effects and targeted delivery to the affected area. Various local drug delivery systems have been developed, including fibers, gels, strips, films, micro particles, and nanoparticles. These systems aim to deliver antimicrobial agents directly to the periodontal pocket, where they can effectively combat periodontal pathogens. [13]

4.1Examples of Local Drug Delivery Systems:

4.1.1.Tetracycline Fibers: Tetracycline fibers, introduced by Goodson in 1979, are impregnated with tetracycline to provide sustained release of the antibiotic for up to 10 days. Studies have shown their effectiveness in reducing pocket depth, bleeding on probing, and periodontal pathogens. [14]

4.1.2Doxycycline Polymer (Atridox): Atridox is a bioresorbable gel system containing doxycycline. It provides a rapid initial release of doxycycline, followed by gradual release over seven days. This sustained release maintains effective antibiotic levels for extended periods. [15]

4.1.3Minocycline: Minocycline can be locally administered through various forms, including films, microspheres (Arrestin), and ointments. Minocycline films have demonstrated complete elimination of periodontal pathogens within 14 days, while Arrestin provides sustained release over 14 days.

Local drug delivery offers a promising alternative to systemic therapy for the treatment of periodontal diseases. These systems provide targeted delivery of antimicrobial agents, minimizing systemic side effects and improving treatment outcomes. [16]

5. ANTISEPTICS AND ANTIMICROBIALS: ESSENTIAL AGENTS IN PERIODONTAL CARE

The effective management of periodontal disease, a chronic inflammatory condition that affects the supporting structures of the teeth, demands a comprehensive approach that targets crucial factors, including the control of subgingival microflora, the bacteria that reside beneath the gum line. Antiseptics and antimicrobials play a pivotal role in achieving this goal by directly eliminating or inhibiting the growth of these harmful microorganisms.

5.1. Topical Antiseptics: A Targeted Approach

Two notable topical antiseptics that have demonstrated efficacy in addressing subgingival microflora are 10% povidone-iodine and 0.1% sodium hypochlorite. Povidone-iodine is administered subgingivally for a 5-minute application, while sodium hypochlorite can be applied subgingivally by patients using an irrigation device. These antiseptics offer effective, safe, convenient, and cost-effective methods for managing periodontal pathogens and addressing various forms of periodontal diseases.

5.2.Over-the-Counter Mouthwashes: A Daily Defence

A variety of over-the-counter antiseptic mouthwashes are readily available for daily oral care and can effectively reduce bacterial counts in the mouth. Common ingredients in these mouthwashes include chlorhexidine (CHX), hydrogen peroxide (H2O2), cetylpyridinium chloride (CPC), povidone-iodine (PVP-I), and essential oils. These antimicrobials work by disrupting bacterial cell membranes, leading to their demise. [17]

5.3. Chlorhexidine Digluconate (CHX): The Gold Standard

CHX is considered the gold standard in antiseptics due to its potent antimicrobial activity and sustained effect. It is widely used in clinical settings to control periodontal pathogens and prevent plaque buildup. While CHX is generally safe and well-tolerated, it can cause minor side effects, such as staining of teeth and tongue. [18]

5.4. Hydrogen Peroxide (H2O2): A Dual-Action Antiseptic

H2O2 is a versatile antiseptic that acts as both an oxidizer and a disinfectant. It is effective against a wide range of microorganisms, including bacteria, viruses, and fungi. H2O2 is commonly used in wound care, oral hygiene products, and as a surface disinfectant. [19]

5.5 Cetylpyridinium Chloride (CPC): A Common Alternative

CPC is a quaternary ammonium compound commonly found in over-the-counter mouthwashes. It is an effective broad-spectrum antimicrobial that is less likely to cause staining than CHX. However, CPC may have a slightly shorter duration of action than CHX.

5.6 Povidone Iodine (PVP-I): A Versatile Antiseptic

PVP-I is a combination of iodine and polyvinylpyrrolidone that provides a broad-spectrum antimicrobial effect. It is effective against a wide range of microorganisms, including bacteria, viruses, and fungi. PVP-I is commonly used in wound care and oral hygiene products.

5.7. Essential Oils: Natural Antimicrobial Alternatives

Mouthwashes containing essential oils, such as thymol, menthol, eucalyptol, and methylsalicylate, have been used for centuries to promote oral hygiene. These oils have antimicrobial properties and contribute to the flavor and fragrance of mouthwashes.

5.8. Herbal Mouthwashes: Emerging Alternatives

Herbal mouthwashes are gaining popularity as potential alternatives to synthetic antiseptics. Some studies have shown that herbal mouthwashes containing tulsi, neem, Triphala, and turmeric can be effective in reducing plaque and gingivitis. Some example like colgate plax, Listerine Naturals, Himalaya Oro-T Oral Rinse. [20]

6. CONCLUSION

The effective management of periodontal disease demands a comprehensive approach targeting crucial factors such as subgingival microflora balance. Conventional methods like scaling and root planing play a pivotal role in inducing positive changes in the subgingival biofilm. Systemic antibiotics, including amoxicillin, metronidazole, and doxycycline, are instrumental in managing various forms of periodontal diseases. Local drug delivery systems, exemplified by tetracycline fibers, doxycycline polymers, and minocyclines, offer sustained antimicrobial effects for persisting pockets. Antiseptic mouthwashes, featuring chlorhexidine, cetylpyridinium chloride, povidone-iodine, hydrogen peroxide, and essential oils, contribute significantly to subgingival pathogen control. Herbal mouthwashes are emerging as potential cost-effective alternatives, showing comparable efficacy with synthetic formulations, but further long-term clinical investigations are warranted for standardization. A nuanced approach integrating conventional and alternative interventions, tailored antibiotic regimens, and judicious use of local drug delivery systems is essential for comprehensive periodontal management. Continual research emphasis remains paramount for refining and enhancing treatment protocols, ensuring optimal outcomes in periodontal care. Antibiotic resistance is a growing concern in the treatment of periodontitis. While there is evidence of resistance to certain antibiotics, such as amoxicillin, clindamycin, and metronidazole, the overall levels of resistance are not yet critical. However, it is important to use antibiotics judiciously and responsibly to prevent the further development of resistant strains. Antibiotic interventions, such as the use of point-of-care diagnostics and educational initiatives, can help to ensure that antibiotics are used appropriately and effectively.

7. Conflict of Interest: the authors that there is no conflict of interest regarding the information presented in this document or related research.

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