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Local Drug Delivery – An Overview

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ABSTRACT

Periodontitis is an chronic inflammatory disease initiated by microorganisms. Various treatment modalities have been proposed to reduce the microbial plaque and sometimes not always they have been rendered successful owing to the morphology of the root and also location of lesion. Controlled release of antimicrobial has reached a new summit thereby improving the gingival and periodontal condition. It's utilised to help in mechanical debridement. In periodontology literature various drugs and delivery systems have been tried and produced promising results. Therefore this review focuses on the concept of local drug delivery.

Keywords: Periodontitis, Mechanical therapy, Systemic therapy, Local drug delivery.

Introduction

In the periodontal pocket the bacteria is present as a complex and structured biofilm and this reaches far subgingivally in case of deep periodontal pocket and hence making the mechanical debridement difficult. To enhance these procedures the local drug delivery of various antimicrobials as adjunct to mechanical debridement. [1]

II. Limitations of mechanical therapy

Failure to reach the instrument to base of pocket, and retention of the microbes in grooves and pockets and dentinal tubules, migration of periodontal pathogens from other sites and tissue invasive pathogens.[2] According to Max Goodson in 1979 when u locally deliver the antimicrobial it gives a 100 fold higher concentration of the drug in the subgingival site thereby reducing the total body concentration or dose by 400 fold hence reducing the resistance of the drug in other non-oral sites.[3]These three principles – site, concentration, and time – are the key parameters in the optimization of local pharmacologic treatment.[4]

III. The sub gingival drug-microbial contact time

An adequate drug and microbial interaction is necessary so that the drug is not washed away by GCF and can exert its bactericidal or bacteriostatic effects. An assumed pocket volume of 0.5 mL and a GCF flow rate of 20 μ L/h Goodson estimated that half time for an non-binding drug will be about 1 minute. Even highly concentrated drug would be diluted below the minimal inhibitory concentration and hence if the agent can bind to surface and be released in its active form a prolonged antibacterial effect can bd expected.[5]

IV. Ideal requisites of local delivery system [5]

The drug must be delivered to base of pocket at microbiologically efficacious concentration. It should exert its action for particular period of time and against periodontal pathogens and not on commensal. They should have proper retention and importantly no emergence of bacterial resistance.

V. Objectives [5]

Maintain therapeutic levels for adequate period of time to kill or inhibit the pathogen and as an adjunct to regenerative periodontal therapy.

VI. Classification6

Personally applied (in patient home self-care)

Non-sustained subgingival drug delivery: Home oral irrigation, home oral irrigation jet tips, traditional jet tips, oral irrigation (water pik) and soft cone rubber tips (pik pocket)

Sustained subgingival drug delivery:

Professionally applied (in dental office)

Hollow fibres, dialysis tubing, strips, and films are all examples of controlled release devices.

Based on the duration of medicament release

Sustained release devices- Drug delivery for less than 24 hours.

Controlled release devices-Releases the drug 1 day or for at least 3 days following application.

VI. Advantages of LDD [7]

Good patient compliance, improved pharmacokinetics, drug access to the site of disease is easy, lowered the total drug dosage, no risk of emergence of resistant microorganism, adequate concentration at the site of action and maintains the drug level for a sufficient period of time

VII. Disadvantages [7]

Time-consuming, difficult in placing antimicrobial agent into deeper periodontal pockets & furcation lesions and personal application of antimicrobial agents by patientat home self-care procedure is compromised.

VII. Indications [7]

Indicated in refractory periodontitis, in sites where instrumentation accessibility for scaling and root planing is difficult in case of, deep periodontal pockets, failure to respond following repeated scaling and root planning in case of localized pockets and alternative to antibiotics in areas having acute periodontal abscess

VII. Contraindications [8]

For pregnant or lactating patients if drug shows harmful effects, in aggressive form of periodontal disease where systemic antibiotics is more effective and in patients who are allergic to components of LDD

VIII. Mechanism of drug release:9

- Solvent controlled' systems based on macromolecular matrix permeability to small molecules after matrix swells in a hydrated medium
- Reservoir systems' - by drug diffusion across a polymeric membrane
- The rate and extent of chemical bond destruction, as well as the erosion of the polymeric matrix, influence the rate of drug release in chemically controlled systems.

IX. Antibiotic Resistance Associated with Local Drug Delivery Systems: [10]

Local drug provides a high concentration of the drug in specific sites. Sublethal amount of the drug leaks after placement therefore potential for resistance in other non-treated sites can exist. P.gingivalis, P.intermedia, F.Nucleatum, and P.Anaerobius developed resistance after being exposed to sub-inhibitory amounts of metronidazole or minocycline.

Various drug delivery systems that has evolved through years [11,12,13,14,15]

Mouth rinses and irrigations- inadequate drug concentration, non -sustained release. Frequent administration is required, no adhesion of the drug

Fibres, strips, films and microparticles- discomfort during placement, foreign body response, poor retention of drug,

Biodegradable nanoparticles, inadequate system retention in periodontal pocket, easier implantation, decreased bacterial resistance with strong penetration due to nano-sized particles

Mucoadhesive, biodegradable nanoparticles, lowered incidence of bacterial resistance and good retention of system.

X. Conclusion

With greater understanding of the etiopathogenesis of periodontitis, researchers and clinicians are becoming more interested in finding a novel therapeutic strategy to battle the tissue loss produced by the complex interaction between pathogenic microorganisms and host defence mechanisms.

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