Subgingival irrigants used in Periodontal Therapy

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Abstract
Currently, the focus in periodontal medicine has changed from periodontal surgery to periodontal medicine. The major cause of periodontal disease is the chronic inflammation caused due to the accumulation of dental plaque. Much of the new research is directed at more ergonomic and economic means of plaque control that have the efficacy over traditional methods. Due to the shift in the focus from periodontal surgery to periodontal medicine, the field of plaque chemotherapy is expanding with the new and improved methods of application of antiplaque chemical agents in the interdental and subgingival sites of the intended action. The main purpose for the use of subgingival irrigants is to non-specifically reduce the bacteria and their by products that often lead to initiation or progression of the periodontal disease. Supragingival irrigants help to disrupt and dilute the marginal bacteria and their byproducts, thus helps to prevent gingivitis. Subgingival irrigants interfere with the complex ecosystem that is responsible for the destruction of the periodontium in susceptible host.

Introduction
The periodontal disease represents a group of localized microbial induced infections that involve gingival and the supporting tissues of the teeth. There are various evidences suggesting the role of facultative and obligate anaerobic bacteria as the primary cause of periodontal disease.(1) The control of the progression and the severity of periodontal disease implies a controlled reduction of either the entire microbial plaque mass or atleast those microbes which are considered to be pathogenic. The control of periodontal disease is routinely performed in the dentist's office by mechanical scaling and root planning (SRP).(2) Mechanical root debridement, both with and without surgical access into subgingival sites, is a prerequisite for controlling periodontal infections. Clinical improvement occurring after mechanical root debridement is directly related to the degree to which subgingival microbial plaque is removed or reduced.(3-5) Subgingival mechanical root debridement not only results in suppression or eradication of putative periodontal pathogens but also induces higher titers of possibly protective systemic antibodies to these organisms and leads to increased proportions of beneficial streptococci possessing low or negligible pathogenic potential.(6) SRP is the treatment modality with proven clinical effectiveness in terms of reducing inflammation, decreasing probing pocket depth and improving the clinical attachment level (CAL).(7-9) SRP has some limitations such as difficulties in accessing deeper pockets, furcation areas and root concavities and difficulty to remove microbial pathogens that are penetrated into dentin tubules and those that are residing in lacunae and concavities.(10,11) Thus this has lead to the adjunctive use of antibacterial agents usually in the form of subgingival irrigants or systemic antibiotics. Supra and subgingival irrigants have the potential to be used by the therapists and the patients to help suppress the bacterial growth. The biologic rationale for performing supra and subgingival irrigation is to non-specifically reduce the bacterial load and their by products that often lead to the initiation and the progression of the periodontal disease.

Subgingival irrigation has a non specific action of flushing the periodontal pocket and thus it can effectively alter the quality and quantity of subgingival plaque associated with chronic periodontitis.(12,13) The potency of locally applied antimicrobial agents in periodontal therapy usually depends on obtaining a adequate subgingival delivery of the agent, acquiring sufficient contact time between the antimicrobial agent and the target micro-organisms and achieving effective concentrations of the antimicrobial agent. Failure to properly achieve one or more of these parameters is the reason for relative ineffectiveness of many local antimicrobial drugs in periodontics.(14)

Commonly used irrigants for the purpose of pocket irrigation as per literature are: water, normal saline, hydrogen peroxide, povidine iodine, ozonised water, chlorhexidine, metronidazole, tetracycline, sodium bicarbonate etc.

Irrigating solutions
Water: The majority of studies reviewed had used a placebo agent as control including water and saline.(15-18) These studies imply that the physiological flushing of the pocket itself is responsible for the primary therapeutic effect of irrigation, regardless of the irrigant used. Among the individuals with mild to moderate periodontitis, it was reported in 2005 that routine oral hygiene maintainence along with adjunctive irrigation therapy was associated with the significant reduction of proinflammatory cytokines (interleukin 1-b, and prostaglandin E2) in the gingival crevices compared to oral hygiene maintainence without irrigation.(19)

Hydrogen Peroxide: Earlier reports by Wenstrom et al showed that professionally performed periodic subgingival irrigation with hydrogen peroxide used alone or together with thorough mechanical debridement has a significant therapeutic effect on clinical or microbial parameters.[20]

In 1982 Wolff et al studied the effect of 3% H2O2 on gingival inflammation and concluded that 3% H2O2 is effective in reducing pocket depth of more than 4 mm but it showed no effect on bleeding another gingival indices. Studies conducted by Jones CM et al showed that 1.5% hydrogen peroxide was of no therapeutic value in the prevention or treatment of experimental gingivitis when used as a mouthrinse or in an oral irrigator. Frequent professional application of hydrogen peroxide appears to be of some advantage in the patients infected with A. ctinobacillus actinomycetemcomitans.[21]

Studies conducted by Wikesjo et al reported the effects of subgingival irrigation with hydrogen peroxide biweekly until A. actinomycetemcomitans was no longer detected by selective culture at 6 months. They concluded that the irrigation regime tested had some potential to suppress A. actinomycetemcomitans for upto 5 months. The reduction in the rates below detectable levels seems related to initial number of cultivable bacteria from the periodontal pockets. It was found that higher the number of A.actinomycetemcomitans, the longer it took to eradicate them from the pocket.[22]

Povidine Iodine: Rosling et al and Christersson et al assessed the value of povidone-iodine irrigation of periodontitis lesions as an adjunct to subgingival debridement in a controlled clinical trial.[23,24] At 12-months post-treatment, significantly more deep periodontal pockets experienced 2 mm or more in gain of clinical attachment after ultrasonic root debridement with a diluted povidone-iodine solution (final concentration 0.05% free iodine) than with physiological saline. The enhanced healing appeared to be due to a better suppression of subgingival periodontal pathogens. The adjunctive benefits of the povidone-iodine pocket irrigation were apparent when used with a nonsurgical ultrasonic root de-bridement therapy, but not with modified Widman flap surgery.

Rosling et al and Hamada et al reported a favorable clinical and microbiological effect of adjunctive povidone-iodine irrigation in periodontitis treatment including furcation lesions on multi-rooted teeth.[25,26] Subgingival povidone-iodine irrigation with no other treatment produced, after 15 days, significant decrease in gingival inflammation, a reduced number of plasma cells, and a smaller volumetric density of infiltrated gingival connective tissue in advanced periodontitis sites. After pocket irrigation with a diluted povidone-iodine solution (0.2% free iodine), a greater than 2-log subgingival decrease occurred immediately in black-pigmented, gram-negative anaerobic rods.[27] Nakagawa et al compared the bactericidal effects of three different concentrations of the subgingivally delivered povidine-iodine solution. Significant reduction in colony forming units was observed with the use of undiluted solutions, but 10% and 20% dilutions did not produce the same reductions. At several sites total CFU was reduced to less than 1%, which was not same for the sites irrigated with saline. Iodine used alone or in combination with other over the counter agents has some advantages such as low cost to the patient and very low probability of bacterial resistance. There are various disadvantages which include sensitivity (allergy) to iodine and potential to cause staining of the teeth. Staining may be prevented by brushing with a dentrifice or immediately swabbing the teeth with hydrogen peroxide after the use of povidine-iodine solution.[28]

Ozonized water: The application of ozone for periodontal purpose is mostly done is aqueous, gaseous and oil form. Its use in aqueous form is simple and safe as compared to gaseous form. Ozonized water when compared to 2.5% sodium hypochlorite solution had a comparable antimicrobial activity and the fibroblast metabolic activity was high when the cells were treated with ozonized water.[29] Subgingival irrigation with ozonized water has successfully been used in the treatment of aggressive periodontitis. Use of ozonized water in the patients undergoing orthodontic treatment showed improvement in gingival inflammation.[30]

Dodwad et al. conducted the study comparing the effects of oral irrigation with ozonated water, 0.2% chlorhexidine and 10% povidine-iodine in the patients diagnosed with chronic periodontitis and stated that local ozone application serves as a potent atraumatic, antimicrobial agent to treat periodontal disease non-surgically. It may also serve as an important tool during supportive periodontal therapy.

Ozone generators available commercially for dental use are: Healzone (KaVo) and Ozotop (TTT).[31]

Chlorhexidine: Chlorhexidine (CHX), a bisbiguanide compound posseses a broad spectrum of antimicrobial activity. This property along with other properties like safety, effectiveness, substantivity and lack of serious side effects and lack of toxicity allows it to be used more frequently as a mouthrinse. Multiple professional subgingival irrigations with 1% chlorhexidine or saline at monthly intervals following root instrumentation have been demonstrated to be effective alternatives to conventional scaling and root planning. Weekly irrigation with 2% chlorhexidine during the first month of root debridement have shown to reduce the number of P.gingivalis more as compared to scaling and root planning alone, 11 weeks post operatively. The use of chlorhexidine and irrigators together appears to be more effective than when used as a mouthrinse for the purpose of altering the subgingival microflora.[32] Chlorhexidine irrigation or gel placement inside the periodontal pockets during mechanical root debridement generally provides no adjunctive clinical

benefits .In comparison, Reynolds et al found better probing depth reductions among moderate (4-6 mm) but not deep, periodontal sites using 0.12% chlorhexidine as an coolant during ultrasonic root debridement.[33] Transient (2-3 months) adjunctive improvements in clinical periodontal attachment also may be attained by repeated pocket application of a 2% chlorhexidine solution or gel over a 3-week period following periodontal debridement.[34] The lack of clinical efficacy of chlorhexidine with nonsustained subgingival delivery approaches may be due to use of sub-therapeutic chlorhexidine concentrations during the drug's brief subgingival exposure following pocket irrigation and the apparent lack of chlorhexidine substantivity to root surfaces which may be the result of serum protein binding of chlorhexidine upon its introduction into subgingival sites demonstrating inflammation and bleeding.[35] The improved clinical findings detected with repeated chlorhexidine pocket applications after the resolution of inflammation and bleeding by mechanical root debridement supports this hypothesis.

Metronidazole: Linden and Newman et al in their study found out that a simple daily oral hygiene regime combined with daily subgingival irrigation with 0.5% metronidazole or placebo was effective in reducing periodontitis for an additional 8 week time and comparatively more sites improved in the metronidazole group.[36]

Tetracycline: Aqueous tetracycline-HC1 solutions irrigated inconcentrations of 5-50 mg/ml (O.5-5%) and for short irrigation times (1-2 ml irrigated for 20 seconds) providedno adjunctive benefit beyond that attained byconventional subgingival debridement. However, a higher tetracycline-HC1 solutionconcentration of 100 mg/ml (10%) (made by dissolvingat 40°C the contents of six 250-mg tetracycline-HC1 tablets into 15 ml of water) and a longer irrigationtime (10-15 ml of solution irrigated over 5 minutes) yielded significantly greater mean 6-monthimprovement in clinical attachment level than root debridement alone (mean 1.8 versus 1.0 mm, P=0.034, Wilcoxon signed-rank test).[37] However, the low pH of the 10% aqueous tetracycline solution (47)may cause soft tissue irritation and excessive tooth sensitivity.

Fluorides: Mazza J et al in their study concluded that subgingival irrigation with 1.64% stannous fluoride was more effective than 0.4% stannous fluoride or saline in decreasing the motile bacteria and spirochetes in the patients of advanced periodontitis when used for several weeks.[38]

Discussion

The primary objective of plaque removal is the subgingival plaque removal and control. Subgingival plaque removal from the root surface by conventional method can be effective but it is time consuming and technique sensitive. Literature suggests that that inability to remove all the subgingival plaque increases the pocket depth to more than 4 mm. Due to the accumulation and maturity of subgingival plaque, periodontal breakdown occurs.[39] Therefore it is not always possible to achieve adequate or complete debridement. This has lead to the adjunctive use of antibacterial agents usually in the form of subgingival irrigants or systemic antibiotics, to overcome the shortcomings of the conventional treatment.

The primary purpose of irrigation is to nonspecifically reduce the bacteria and their by-products that lead to the initiation or progression of periodontal diseases. Reports on pocket irrigation as a mono-therapeutic method or as a complimentary approach to enhance the results of scaling and root planing have been inconsistent and controversial. Differences among the reports may be related to variations in disease severity and in methodologies. The American Academy of Periodontology published the guidelines for subgingival irrigants, according to which the subgingival irrigants must have:

1. A noticeable and long lasting effect on the composition of the subgingival plaque.
2. A speculative and sustained effect on the clinical parameters of periodontitis.
3. An improved effect on periodontitis than SRP alone.
4. In addition to these all the subgingival irrigants used and the techniques used to deliver them must be safe.[40]

Conclusion

The application of the local chemotherapeutic drugs has some advantages over the systemic drug use, however the topical agents delivered in the form of irrigating solutions may fail to affect the periodontal pathogens at the base of the pocket, in the furcation areas and in other inaccessible areas. In addition to these, the agents available for home irrigation don't have a long term effect due to the rapid decrease in the concentration of the agent and high turnover rate of sulcular fluid. The application of the irrigating solutions locally or in the form of mouthrinses depends upon first order kinetics in order to provide a long lasting effectiveness.

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