Antiseptics and Antimicrobials in Oral Health Care: A Brief Overview

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The oral environment forms a special ecological niche for micro-organisms where the hard non-shedding surfaces of teeth come into contact with the soft oral mucosal surfaces. The oral environment is also prone to wear and tear during daily masticatory and other oral functions. The oral microbes, inhabiting such an environment, could from time to time turn into opportunistic pathogens provided that the delicate balance between host defence and microbial virulence tips in favour of the microbes. Common oral diseases like dental caries, gingivitis and periodontal diseases are among the most well known examples of opportunistic diseases. Dental infections or abscesses are usually oral complications consequential to the above problems. Hence prevention of common oral diseases and maintenance of oral health would be in the best interest of everyone.

The most prevalent oral diseases that affect the general population of Hong Kong are caries and periodontal diseases. The level of tooth decay among young age groups (e.g. 12-year olds) ranked among the world’s lowest, while the level of caries and periodontal diseases in middle age adults (35- to 44-year old) was found to be similar to most developed countries e.g. USA, UK, and Australia. Non-institutionalized older persons were found to have experienced more tooth decay and periodontal diseases than the middle aged group. Among all adult subjects surveyed, 13-18% and 60-74% of them perceived that they suffered from oral abscess and bad breath respectively. An earlier survey reported 5% of the Hong Kong elderly population suffered from oral ulcerations.

Regular and appropriate utilization of oral health care products would be one smart way to prevent the occurrence of common dental diseases. Other than the recommended daily self care like brushing and flossing, many therapeutic agents are available across the counter for caries or gum disease prevention. Sometimes clinicians can prescribe agents to alleviate signs and symptoms of common oral problems/diseases. Example of commercially available agents are various formulations of mouthrinses with antiseptics such as chlorhexidine digluconate, tricolsan, cetylpyridinium chloride, phenolic compounds, heavy metals, and detergents, alone or in combination aiming to kill or control the oral microbes and hence the oral diseases that they cause. Mouthrinses with fluoride can remineralize initial caries lesions. General medical doctors and dentists may sometime utilize antibiotics to assist control of oral abscess/infections.

Health care professionals should acquire basic knowledge so that appropriate information and instructions can be given to whoever needs these at the right time. One should have a concept of who may benefit from antiseptic or the antimicrobial agents. What is the best agent for that particular purpose in the market? And how should it be used? What are the expected benefits after using such agents?

Before answers to the above questions are discussed, one has to understand the concept of oral biofilm.

Oral biofilm: a polymicrobial community developed on non-shedding hard surface

Dental plaque or the oral biofilm is a microbial community formed by oral microbes tightly bound to a solid substrate and each other by means of exopolymer matrix. Micro-organisms in a biofilm exhibit properties different to those exhibited when they are in isolation. Antagonism, synergy and commensalism among the various microbial species selects and shapes the population. Essential features of established biofilm could be found in the following homepage: http://www.erc.montana.edu/CBEssentials-SW/bf-basics-99/bbasics-01.htm.

In brief the exopolymer matrix can exist in ordered or disordered forms dependent on its local environment. In addition to preventing the bacterial mass within it from desiccation, the exopolymer matrix also functions to create a local nutrients-rich, pH stable environment for growth and produces enzymes such as β-lactamase, catalase and super-oxide dismutase for protection against host defence. Water channels are also observed within biofilms which permits passage of nutrients, essential enzymes and waste products. Bacterial cell-to-cell communication is observed within oral biofilms. In order to render antiseptic or antimicrobial agents effective in the oral context, mechanical disruption of the targeted biofilm before the chemical antimicrobial therapy is recommended. The theory is that the chemical agent would be effective against oral microbes only when they are in the planktonic phase and not when they exist inside the oral biofilm.

Common antiseptics used in oral health care

The most commonly used agent to prevent and/or reverse early enamel decay is fluoride. Topical fluoride can assist remineralization of early enamel caries lesion and hence has been proven to be effective in caries prevention. Fluoride mouthrinses therefore, are indicated for patients with high caries risk, namely individuals with significant caries...
experience and those with impaired salivary gland function, e.g. patients after head and neck irradiation therapy. Dietary counselling to reduce the oral exposure to cariogenic food substances should normally be delivered as an adjunct to fluoride therapy. The fluoride mouthrinse itself was shown to be able to reduce the number of mutans streptococci, one of the dental decay pathogens, in the human mouth.

Other oral antiseptics or chemical agents that have antimicrobial properties which are commonly used include: quaternary ammonium compounds, phenolic compounds, halogens, alcohols, heavy metals and bis-biganuine. These agents are chosen to be active ingredients of oral health care products because on top of their antimicrobial properties, they are safe in their normal working doses, stable over reasonably long shelf-life, and might possess substantivity, i.e. a prolonged contact time between the agent and the microbes on which the agent is to induce its effect. These agents are mainly used to assist oral plaque control and in turn to prevent gum and periodontal diseases.

Chlorhexidine, a bis-biganuine, is among one of the most tested compounds and its anti-plaque properties are well-known. The agent was found to be able to prevent bacterial adhesion onto salivary pellicle and hence render dental plaque/oral biofilm formation difficult. At high concentration it is bacteriocidal and in regular concentration (0.12-0.2%) it is bacteriostatic. It also has good substantivity in the mouth. The chlorhexidine mouthrinse is also commonly used for symptomatic treatment of recurrent aphthous stomatitis/ulcers. The side effects of chlorhexidine mouthrinses, tooth staining, altered taste sensation and mucosal irritation, however, have limited the application of the agent in long term daily home use.

The quaternary ammonium compounds, one example being cetlypyridinium chloride, were shown to exhibit a moderate degree of efficacy as anti-plaque agents. Phenolic compounds like thymol, eucalyptol etc. are considered useful in combination with an individual's own mechanical plaque control, i.e. brushing and flossing etc., but not when used alone. Tricolsan is another phenolic compound which has good research support to its clinical efficacy and has certain level of substantivity. Heavy metals like zinc citrate or stannous fluoride have bacteriocidal/anti-plaque effects. Zinc ions are being used in combination with other active agents in toothpastes or mouthrinses. So far no emergence of resistant microflora has been reported as a result of normal clinical usage of anti-plaque agents/oral antiseptics.

Recently, more and more attention was given to usage of oral antiseptic agents to control halitosis or bad breath. It is believed that the source of halitosis is mainly from the offensive gaseous products of oral anaerobic bacteria colonizing the human tongue. Although mechanical approach alone, i.e. tongue brushing, is effective, reports have shown that the use of certain mouthrinses can assist the control of halitosis originating from the tongue microflora.

Alcohol in mouthrinse products: an update

For many years, alcohol has been used in mouthrinses as a solvent of the active ingredients. Certain commercially available mouthrinses might have this "hydrolcoholic vehicle" of up to 25%. Such high quantity of alcohol in some mouthrinses together with the 2-3 times daily usage may translate to relatively long exposure duration of oral mucosa to alcohol compared to alcoholic drinks. Therefore, other than the more frequently observed hyperkeratostatic mucosal lesion in mouthrinsers, increasing concern is also directed to any association of alcohol-containing mouthrinses and oral cancer. Alcohol free agents are now available in the market for health conscience consumers. Theoretically, acetaldehyde, rather than alcohol itself, is responsible for the cocarcinogenic effect of alcohol. Acetaldehyde can be generated by bacterial alcohol dehydrogenase, including those of oral bacteria after ingestion of alcohol. Poor oral hygiene and consumption of highly concentrated alcoholic beverages, hence, are among two of the risk factors for upper aerodigestive tract carcinogenesis. The alcohol itself rather, is considered to act as a solvent that enhances the penetration of carcinogenic compounds into the mucosa. Chemical plaque control by chlorhexidine, after a 3-day period, however, reduced the in vitro acetaldehyde production significantly indicating the agent is effective in eliminating the oral microbes that convert alcohol into tumour promoting acetaldehyde. Such antimicrobial effect of chlorhexidine in commercial alcohol based formula appeared over and on top of the potential danger effect of its vehicle. Insufficient information is available at the present moment to indicate if there is any relationship between use of alcohol-containing mouthrinses and the development of oral cancer. On the other hand, there is no evidence available showing that alcohol can increase the anti-plaque efficacy of mouthrinses.

Hot salt water mouth bath

Hot salt water mouth baths in the form of one teaspoonful of common salt in a domestic trumbler of hot water at a temperature as would be taken for a fresh cup of tea is a "folklore" type oral wound management method passed on for years in dental schools. The belief is, the heat of the saline solution, which is roughly isotonic with body tissues, would produce a therapeutic increase in blood flow to the affected area that promotes drainage of any exudate as well as wound healing. Some patients also practice similar home care approach when they experience dental abscesses. Interestingly enough, there is no report testing if hot salt water mouth baths really help in promoting oral wound healing.

Common antimicrobials used in oral health care setting

Dental caries in form of decayed tooth cavities are treated normally using surgical approaches and would not require usage of antimicrobials. Utilization of local or systemic antibiotics in management of periodontal diseases, however, is not uncommon. In general, antimicrobial agents are used as an adjunct to mechanical periodontal therapy for individuals suffering from advanced and/or aggressive forms of the diseases. Periodontitis patients with generalized systemic disease that affects the host immune response may also benefit from adjunctive antimicrobial therapy. The main aim in usage of the antimicrobials is to eradicate certain gram-negative anaerobic periodontopathogens. Commonly used antimicrobials include penicillins, tetracyclines, metronidazole and clindamycin. Agents like tetracyclines and metronidazole are also used in locally delivered formats. Some agents are also being used in combination for systemic administration. Antibiotics like penicillin, metronidazole and clindamycin are used also for management of oro-facial abscesses or infections.
They are broad spectrum antibiotics against gram-positive oral species and/or specific against anaerobic bacteria. The agents are preferably administered following mechanical instrumentation, i.e. after debridement of the periodontal pocket biofilm or drainage of the dental alveolar abscesses. Theoretically, culture and sensitivity test should be conducted before any antimicrobial is used in the management of periodontal diseases or dental alveolar infections. However, the fact that anaerobic culture and sensitivity tests take weeks forces clinicians to prescribe empirical therapy at the outset using common knowledge about oral microbial infections and antibiotic sensitivity. In case the sensitivity profile turns out to be different after culturing, the clinician can consider changing antimicrobial treatment regime taking into consideration of the current clinical condition of the affected patient.

Often times antibiotic combinations are used. A common example is amoxicillin together with metronidazole. Another very common usage of systemic antibiotics e.g. penicillin in oral health care is for prevention/prophylaxis against bacterial endocarditis. Avocates of evidence based dental practice, for instance experts in the Cochrane collaboration reviewed the available evidence to investigate if the practice is worthwhile continuing? Unfortunately, the result was inconclusive/confusing. Oral health care professionals might have to wait for more evidence before being able to judge if this practice remains rational or not?

Local delivery of antimicrobial agents is a periodontal treatment concept developed during late 70's. Such idea is favoured because a high concentration of the agent is being delivered at the site where its action is required. This approach also minimizes possible side effects because effective systemic dose of the antibiotics would be low. Dentist or periodontist is the one who prescribes and administers the agent to patients, usually in situations when alternative approaches to periodontal surgery are being tried. With the advance in dental implant therapy, local delivery of antimicrobials finds itself useful when infections unfortunately arise around dental implants.

What are the expected clinical outcomes for oral antiseptics and antimicrobials? Where do we go from here?

Topical fluoride has been well proven to be an effective agent for dental decay prevention. Similarly, efficacy of antimicrobial use for control of dento-alveolar infection would be easily demonstrated. The current understanding indicates that oral biofilms should be disrupted before chemical antimicrobial therapy is applied. Systemic antimicrobials can often be used to alleviate the acute symptoms of dental infections, those who are affected should be referred to a dentist for follow-up and management of the underlying causes of an acute infection. When clinical researchers seriously look at research/trial results related to antiseptics or antimicrobials used in prevention and/or management of gum/periodontal diseases, the outcomes are largely disappointing, one reason being that the quality of the available randomized clinical trials often does not meet recommended standards. The other reason is that the observed clinical benefit or significance of the agent tested, without taking into consideration of the quality of the trial, is small. In other words, the user of the agent would not experience any “tangible benefit” and the therapeutic effect is “small” in the eyes of the clinicians.

In this new millennium, evidence-based medical and dental practice should be our current way forward. The biggest challenge now would be the limited amount of information of acceptable quality which is available. Clinicians and scientists would have to work hard as well as be patient for the eventual acquisition, analysis and effective dispersal of evidence that will help to refine and drive our future practice. Practitioners should now get themselves familiar with and be psychologically prepared to take on paradigm shifts once newly established evidence regarding usage of antiseptic and antimicrobial agents in oral health care becomes available.

References