Malaysian Dental Journal (2015)
Vol 38; Issue 2

MALAYSIAN DENTAL JOURNAL

Sweetened medications and dental caries- A mini literature review

Shanmuga Priya, Sabitha Sudharsan, Arunmozhi Ulaganathan, Kadhiresan Rathinasamy, Jebin Paul Nesaline

Sri Venkateshwara Dental College & Hospital, Tamilnadu Dr.MGR Medical University

ABSTRACT

Caries is the most common occurring disease in the oral cavity, with root caries being the major cause of tooth loss in older adults. Caries is initiated when bacteria and fermentable carbohydrates fuel acid production and cause demineralization. There are known clinical and behavioural risk factors involved in the production and progression of caries. For example, conditions that compromise good oral hygiene behaviours and oral health are positively associated with caries risk. But long-term regular use of medications containing sucrose may indirectly causes decay by altering plaque composition and pH. Studies have shown positive association between intake of these drugs and dental caries. These cariogenic medications are present both in modern and alternative medicine. Considering the cariogenic and erosive potential of sweetened and acidic medications prescribed, the health professionals should educate the patients about the need for adequate oral hygiene after each dose of medication as a primary step for minimizing the risk of dental caries. This is a short review of literature, describing the effect of long-term use of sweetened medications in causing dental caries, without adequate plaque control.

SWEETENED MEDICATIONS AND DENTAL CARIES – A MINI LITERATURE REVIEW

Dental diseases are amongst the most widespread diseases around the globe[1], with plaque related diseases namely dental caries and periodontal disease being the most common oral diseases and the most prevalent infectious disease occurring in all age groups[2]. Maintaining oral health is essential for one's overall general health, growth and development. With advances in technology and medicine that prolongs life expectancy, the proportion of senior citizens will continue to rise worldwide. These untreated dental conditions can have a significant impact on quality of life by increasing the risk of other chronic ailments such as cardiovascular diseases, respiratory diseases, and etc3,4,5.

PREVELANCE OF DENTAL CARIES

A very extensive and comprehensive National Health Survey was conducted in 2004 throughout India in order to ascertain the oral health status and prevalence of dental disease in representative age groups[6]. The prevalence of dental caries for various age groups were examined, for both coronal and root surfaces:

- 51.9% in 5 year-old children
- 53.8% in 12 year-old children
- 63.1% in 15 year-old teenagers
- 80.2% in 35-44 years-old adults
- 85.0% in 65-74 years-old adults

Root surface caries is initiated when gingival recession exposes root surfaces to the oral environment. It is the major cause of tooth loss in older adults. Nearly half of all individuals aged 75 and older have root caries[7]. The cohort evaluation of elderly, aged 79 years old or older (mean: 85.1 years old) with a mean of 19.4 remaining teeth showed

that nearly all subjects (96%) had coronal decay, nearly two-thirds (64%) of the individuals had root caries experience, and 23% had untreated root caries[8]. Utilization of dental services was high among the dentate elderly, with nearly three quarters visited a dentist within the past year with complaints of pain and sensitivity due to caries[8]. Those with active coronal or root decay were more likely to be male with a history of tobacco use and who have not visited a dentist within the past year[9]. The most recent studies clearly indicate a marked increase in the prevalence of caries. This global increase in caries prevalence affected all individuals and all surfaces of teeth[9].

ETIOLOGY OF DENTAL CARIES

Miller in 1890 published his chemo-parasitic theory stating that, bacteria in dental plaque metabolise dietary sugars to acids, which in turn dissolve dental enamel and dentine[10]. A modern refinement is that the process is not continuous but cyclical[11]. Periods of acid attack and mineral loss are interspersed with periods of remineralisation, and major destruction occurs if mineral loss is greater than healing[11]. Hence dental caries is related to an imbalance between the tooth structure and oral environment, where microbial flora, diet, host and time play a role in the disease initiation and progression[11].

ROOT CARIES

Root caries is a soft lesion found on a tooth root surface that has lost its connective tissue attachment and is exposed to the environment of the oral cavity[12]. The lesions are usually found at the cemento-enamel junction (CEJ)[13], or are seen to have spread to undermine the adjacent enamel[14] , or a distance apical to the CEJ[15]. Lesions are most often apparent on tooth roots where the gingiva has receded, but up to 10% to 20% of lesions appear subgingivally [16].

Katz *et al*. [14] have described the distribution of root caries among arches and tooth surfaces. Root caries was found most frequently at mandibular posteriors (buccal and proximal surfaces) followed by maxillary anteriors (proximal surfaces), maxillary posteriors (lingual and proximal surfaces) and then mandibular anteriors (buccal and proximal surfaces). Since the incidence of root caries among patients with advanced periodontal disease is high[12], periodontal therapy should always includes a strong caries-prevention program. .

RISK FACTORS OF CARIES

There are known clinical and behavioural risk factors involved in the production and progression of dental caries. They are described in a number of levels, from socioeconomic status to dietary and oral habits[17]. Any condition that compromise good oral hygiene, for example physical and mental disabilities, presence of multiple restorations and periodontitis can increase the risk for dental caries[18].

However, the awareness is lacking among the health personnel and general population about the long-term regular use of medications containing glucose, fructose, or sucrose that can be metabolized to acid, resulting in dissolution of the tooth structure[19]. The lack of awareness among parents on the added sugars in paediatric medicines had resulted in increased incidence of caries among the chronically sick children[20].

Several studies[21,22] have proved the presence of sugar and/ or other fermentable carbohydrates in antacid tablets, antifungal agents, antibiotic solutions and homeopathic products. Elderly with compromised ability in performing oral hygiene procedures due to physical and cognitive impairment has played an important role too.

This group of older adults shows an evidence of gingival recession and loss of periodontal attachment. Patients with periodontal attachment loss who are on sucrose-based medications have an increased risk of developing caries and consequently accumulation of plaque, leading to further progression of periodontal disease[14].

SUGAR IN MEDICATIONS

Pharmaceutical companies use sugars, especially sucrose in large quantities, as a vehicle and to mask the unpleasant taste of certain active ingredients[23].

Sharma and Deshpande previously evaluated the effect of sucrose in commonly used paediatric medications such as Diphenhydramine, Paracetamol and Amoxicillin. The collected plaque sample was tested for its pH after rinsing with these syrups. The drop in the pH of Paracetamol and Diphenhydramine was comparable to 10% sucrose (control)[24].

On the other hand Sahgal *et al.* [25] studied the prevalence of dental caries in children on long-term oral medicines (LOM) in comparison with children who are not on LOM. They concluded that,

1. Liquid oral medications taken for duration of 3 months or more serve as a risk factor for increased level of dental caries.
2. Posterior teeth are much more affected than anterior teeth.
3. Significantly higher caries scores are found in children between 2-6 years who are on LOM.
4. Severity of caries is directly proportional to duration of LOM.

Kulkarani *et al*[26] in 1993 examined 499 paediatric medicines available in India. They found that, majority of the preparations are syrup-based and very few pharmaceutical companies have mentioned about the quantity of sucrose on their label.

An in-vitro study conducted to assess the cariogenic and erosive potential of Brazilian liquid paediatric medicines concluded that many paediatric medications showed high sugar content[20]. The pH values were below critical value and the high acidity values increased the medicine's cariogenic and erosive potentials.[20]

A comparative study[27] which evaluated the pH changes in dental plaque after rinsing with sugared or sugar – free versions of paediatric Acetaminophen solution, concluded that changing of sucrose to non-acidogenic sweeteners was essential to prevent the cariogenic potential of paediatric medicines[27].

ALTERNATIVE MEDICINE

Nowadays homeopathy is a relatively common and popular choice of alternative intervention for the treatment of chronic conditions in children and elderly. This wide range of acceptance is because of its advantages in terms of lower antibiotic exposure, fewer and less serious side effects, absence of drug interactions, and better patient compliance [28].

Supporters of homeopathy point to two unconventional theories: "like cures like"—the notion that a disease can be cured by a substance that produces similar symptoms in healthy people; and "law of minimum dose"—the notion that the *lower* the dose of the medication, the *greater* its effectiveness[29,30]. Homeopathic remedies are produced by substances that derived from plants, minerals, or animals, such as red onion, arnica (mountain herb), crushed whole bees, white arsenic, poison ivy, belladonna (deadly nightshade), and stinging nettle[29].
Homeopathic remedies are often formulated as sugar pellets to be placed under the tongue; they may also be in other forms, such as

ointments, gels, drops, creams, and tablets. Pellets are made of hard sucrose, which is basically sugar[28]. The sugar makes homeopathic remedies sweet and desirable to be taken. When a patient takes a minimum of 5 pellets, 4 times a day (20 pellets) it is equivalent to 1 gram of sugar (or 1/5th of a teaspoon)[29].

An in-vivo study[31] was conducted on forty-five normal and healthy children to compare the change in salivary pH following the use of two homeopathic remedies, Chamomilla 2x and arsenicum 2x, (2x = 1:100 dilution) with a placebo. The study found that there was a significant reduction in salivary pH at 5, 15 and 30 minutes interval in the test group and did not return to baseline values, even after 1 hour of administering the homeopathic medications. It was concluded that the oral health of children on regular homeopathy needs to be monitored – for their medicament composition, frequency of administration, and duration of therapy[31].

PREVENTION

Since the pathogenesis of dental caries is well understood, strategies to prevent caries development would seem to be relatively simple. Either the virulent forces can be reduced or the host resistance can be enhanced. Ways to decrease the virulent forces include: removal of dental plaque (dental biofilm), alteration of dental plaque so that it is less able to metabolise dietary sugars to acids, neutralise the acids within plaque, and remove or reduce dietary sugars[11]. Ways to enhance host resistance include: reduce enamel's solubility in acid, increase the potential for remineralisation of demineralised enamel, and cover enamel surfaces so as to put a barrier between dental plaque and enamel[8]. Awareness and promotion of water fluoridation, fluoride applications, emphasis on proper tooth brushing using a fluoride

dentifrice, flossing, proper diet, and regular dental visits may hinder the progression of future caries, leading to an improvement in oral health[32]. Allen *et al*[33], has suggested that past history of dental caries is generally the best indicator among all in identifying future risk.

Dental practitioners should be aware of the sucrose content of prescribed and non-prescribed medications and educate their patients to ensure adequate oral clearance following each dose of medication, taking cognizance of the following guidelines [23, 24].

1. Patient education about the cariogenic potential of the medications and also importance of tooth brushing after taking these medicines.
2. Providing medications in a tablet form whenever possible.
3. Giving medications at mealtimes instead of between meals.
4. Not taking medications right before bedtime.
5. Use fluoridated toothpaste(1000ppm) or alternatives e.g. a low dose, high frequency fluoride rinse(230ppm fluoride/day or 920ppm fluoride/week), fluoride gel(sodium fluoride 0.9% [9,040 ppm fluoride]), fluoride varnish (sodium fluoride 2.26% [2,260 ppm fluoride])[34] or sugar- free chewing gum after taking medication.
6. Regular preventive care.

CONCLUSION

Based on the literature review, it can be concluded that sweeteners used in medications has the potential to increase the risk of dental caries in susceptible individuals. Doctors and dentists play an important role in advising patients on preventative measures to control the risk of developing oral diseases.

REFERENCES

1. Srivastava R, Nongkynrih B, Mathur VP, Goswami A, Gupta SK. High burden of dental caries in geriatric population of India: A systematic review. Indian J Public Health 2012;56:129-32.
2. CDC (2000) Oral Health in America: A Report of the Surgeon General. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, 2000.
3. Joshipura KJ, Rimm EB, Douglass CW, Trichopoulos D, Ascherio A, Willett WC. Poor oral health and coronary heart disease. J Dent Res 1996;75:1631-6.
4. Mendez MV, Scott T, LaMorte W, Vokonas P, Menzoian JO, Garcia R. An association between periodontal disease and peripheral vascular disease. Am J Surg 1998;176:153-7.
5. United Nations. World Population Ageing, 1950-2050, Department of Economic and Social Affairs, Population Division, New York. United Nations (UN)-2002. Available from: http://www.un.org/esa/population/publications/worldageing 19502050/index.htm. [Last accessed on 2011 Jan 16].
6. National Oral Health Survey and Fluoride Mapping. An epidemiological study of oral health problems and estimation of fluoride levels in drinking water. Dental Council of India, New Delhi, 2004; 32; 67-78.
7. Ingle NA, Chaly PE, Zohara CK. Oral health related quality of life in adult population attending the outpatient department of a hospital in Chennai, India. J Int Oral health 2010;2:45-55.
8. Warren JJ, Cowen HJ, Watkins CM, Hand JS. Dental caries prevalence and dental care utilization among the very old. J Am Dent Assoc 2000;131:1571-9.
9. Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. Amer J of Dent 2009: 22;3-8.
10. Muntz JA. Production of acids from glucose by Dental Plaque material. J Biol Chem 1943:148;225-36.

11. Mairead Antoinette Harding et al. Dental caries: Strategies to control this preventable disease. Acta Medica Academica 2013;42:131-9
12. Hazen SP, Chilton NW, Mumma RD. The problem of root caries. I. Literature review and clinical description. J Am Dent Assoc 1973;86:179-83.
13. Banting DW, Ellen RP, Fillery ED. Prevalence of root surface caries among institutionalized older persons. Community Dent Oral Epidemiol 1980;8:84-8.
14. Katz RV, Hazen SP, Chilton NW, Mumma RD, Jr. Prevalence and intraoral distribution of root caries in an adult population. Caries Res 1982;16:265-71.
15. Vehkalahti M, Rajala M, Tuominen R, Paunio I. Prevalence of root caries in the adult Finnish population. Community Dent Oral Epidemiol 1983;**11**:188-90.
16. Stamm JW, Banting DW, Imrey PB. Adult root caries survey of two similar communities with contrasting natural water fluoride levels. J Am Dent Assoc 1990;12**0**:143-9.
17. J. G. Steele, A. Sheiham, W. Marcenes, N. Fay, and A. W. Walls. Clinical and behavioural risk indicators for root caries in older people. Gerodontology 2001;18(2):95-101.
18. R. H. Selwitz, A. I. Ismail, and N. B. Pitts. Dental caries. Lancet 2007:369(9555): 51-9.
19. Ciancio SG. Medications impact on oral health. J Am Dent Assoc 2004;135:1440-8.
20. Menezes VA, Cavalcanti G, Mora C, Garcia AFG. Pediatric medicines and their relationship to dental caries. Braz J Pharm Sci 2010;46:157-64.
21. Silva M F A, Guimarães J A T L. Potencial cariogenico de medicamentos utilizados no tratamento de doenças do trato resp iratorio e alergia. J Bras Odontopediatr Odontol Bebe 2001;4:383-6.
22. Neves B G, Pierro V S, Silva M L C. Perceptions and attitudes among parents and guardians on the use of pediatric medicines and their cariogenic and erosive potential. Cienc Saude Coletiva 2007;12:1295-300.

23. Bigeard L. The role of medication and sugars in pediatric dental patients. Dent Clin North Am 2000; 44(3): 443–56.
24. Sharma A, Deshpande S. Effect of sucrose in different commonly used pediatric medicines upon plaque pH in human subjects. J Indian Soc Pedod Prev Dent 2011;29:144–8.
25. Sahgal J, Sood PB, Raju OS. A comparison of oral hygiene status and dental caries in children on long-term liquid oral medications to those not administered with such medications. J Indian Soc Pedo Prev Dent 2002;20:144–51.
26. Kulkarni, M.L., Sureshkumar, C. & Venkataramana V. Colourings, flavourings, and sugars in children's medicines in India. BMJ 1993;307:773.
27. Mentes A. pH changes in dental plaque after using sugar-free pediatric medicine. J Clin Pediatr Dent 2001;25:307–12.
28. Bornhoft G, Matthiessen PF. Homeopathy in healthcare—effectiveness, appropriateness, safety, costs. Berlin: Springer; 2011.
29. Hahnemann S, O'Reily WB, editor. Organon of the Medical Art. Palo Alto, California (USA): Birdcage Books; 1996.
30. Teixeira MZ. New homeopathic medicines: Use of modern drugs according to the principle of similitude. Homeopathy 2011;100:244–52.
31. Subramaniam P, Kumar K. Change in salivary pH following use of homeopathic medicines: A preliminary study. Eur J Gen Dent. 2013;2:31–6.
32. Daniel Gati, Vieira RA Review Article Elderly at Greater Risk for Root Caries: A look at the multifactorial risks with emphasis on genetics susceptibility. Int J Dent 2011; 1–6.
33. Allen AY, McNally ME, Fure S, Birkhed D. Assessment of caries risk in elderly patients using the Cariogram model. J Can Dent Assoc 2006;72:459–65.
34. Recommendations for using fluoride to prevent and control dental caries in the United States. Recommendations and Reports. August 17, 2001 / 50(RR14);1–42.

-THIS PAGE INTENTIONALLY LEFT BLANK-