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How to Maintain Oral Health in Children with Respiratory Diseases –Literature Review

SUMMARY

The most frequent chronic respiratory problems in childhood are asthma and cystic fibrosis (CF). The purpose of this paper is to review basic knowledge and recent advances in oral health and associated dental morbidities in children with asthma and CF. This review considered clinical trials and systematic reviews related to oral health in children with CRD. An online base Medline was searched to determine relevant papers, using the combination of the following terms: "asthma", "cystic fibrosis", "caries", "dental erosion", and "oral health". Oral health problems in children with chronic respiratory diseases (CRD) may be influenced by natural course of the disease, pharmacotherapy (inhalation therapy with bronchodilators and inhaled corticosteroids in asthmatic patients, systemic antibiotics and pancreatic enzyme replacement therapy in CF patients), medication administration technique and nutritional habits. Children with CRD may have higher prevalence of oral diseases. Patients and their parents, but also general paediatricians and pulmonologists, should be aware of importance of good oral health. Dental practitioners should be more informed about risk factors and specificities of oral health in these patients. Preventive measures, early diagnosis and effective treatment strategies in children with CRD can reduce occurrence of oral diseases and improve patient's quality of life.

Key words: Asthma, Cystic Fibrosis, Oral Health, Dental Caries, Periodontal Disease, Dental Erosion

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Introduction

Acute and chronic respiratory diseases (CRD) are the most frequent medical problems in childhood. Prevalence of CRD is increasing worldwide, why dental practitioners should be more aware of the specificities of oral health in these patients. Specificities of particular clinical problems in patients with CRD come from natural course of the disease, pharmacotherapy and nutritional risk factors that have not favourable impact on the appearance of oral diseases. Risk factors associated with oral diseases in children are presented in Table 1.

The purpose of this paper is to review basic knowledge and recent advances in oral health and associated dental morbidities in two most common chronic respiratory diseases in childhood - asthma and cystic fibrosis (CF).

Table 1. Risk factors for oral diseases in children

Dental caries	Gingivitis	Dental erosion
• Frequent use of fermentable carbohydrates • Decreased salivary flow and pH • Increased counts of *Streptococcus mutans* and *Lactobacilli*	• Dehydratation of oral mucosa due to the mouthbreathing • Decreased salivary flow and subsequent reduced concentration of secretory IgA • Alteration of immune response	• Frequent exposure of teeth to extrinsic and intrinsic acids • Decreased salivary flow and pH

Material and Methods

This review considered clinical trials and systematic reviews related to oral health in children with CRD. An

online base Medline was searched to determine relevant papers, using the combination of the following terms: "asthma", "cystic fibrosis", "caries", "dental erosion", and "oral health". The last search date was March 31st 2017.

Asthma

Asthma is a chronic inflammatory disease, characterised by episodes of cough, wheezing, chest tightness and difficult breathing. Its prevalence in childhood is increasing worldwide, causing hospital admissions, school and work absenteeism, decreased quality of life and even asthma-related death. Latest Global initiative for asthma (GINA) estimated that the number of people with asthma in the world may be as high as 334 million. Although prevalence of asthma varies widely between the countries, it is estimated that about 14% of the world's children were likely to have had asthmatic symptoms[1]. Besides GINA, numerous national asthma-reduction plans established useful diagnostic criteria and different treatment modalities which resulted in proper diagnosis and decrease of asthma exacerbations.

The cornerstones of modern therapy are inhaled bronchodilators (mostly β_2 agonists) and anti-inflammatory drugs (inhaled corticosteroids (ICS). Systemic adverse effects such as decreased growth velocity, adrenal suppression or osteoporosis are not related with chronic use of low and moderate doses of ICS. Local adverse effects- mostly dysphonia and oral diseases are associated with frequent use of inhaled bronchodilators or chronic use of ICS. Proper techniques of inhalation, use of spacers with metered-dose inhalers (MDI) and good oral hygiene may decrease the incidence of these complications. Most of the children with asthma have a mild disease treated intermittently with inhaled β_2 agonists. Excessive and/or prolonged use of either nebulised or β_2 agonists from MDI can lead to a reduced salivary flow which is essential for oral health. Alteration of protective role of saliva leads to increased number of cariogenic microorganisms[2-4]. A dry powder inhaler (DPI) is a device that delivers asthma medication in size of respirable particle (from 1-5μm in diameter) in mixture with excipients which carries the active drug. Most commonly used carrier is carbohydrate - lactose monohydrate. During inhalation from DPI, drug particles separate from the carrier and carried into small airways in the lungs. Larger, lactose particles, are deposited on the oropharyngeal mucosa which can contribute to elevated caries risk[5].

It has been suggested that asthmatic patients may have a higher risk for oral diseases, either as a result of the medical condition or as adverse effects of medication. A higher prevalence of caries in school children[6] and adolescents[7-9] with asthma compared with healthy children has been reported. Ersin *et al.*[6] demonstrated that the duration of therapy and seriousness of the disease had significant influence on the caries risk in asthmatics. It was speculated that mouth breathing and higher intake of sweet drinks, which are commonly used in an attempt to eliminate the bad taste of the inhaled medication or to reduce the desiccating effect of mouth breathing and reduced salivary flow, may be related to worse oral health in primary dentition[7,8]. On the other hand, several studies with comparable methodology showed no relationship between asthma and caries incidence, regardless the age of the participants[10-16].

It has been reported that asthmatics are in a higher risk to develop dental erosions[17,18]. This was explained by negative influence of frequent consumption of acidic soft drinks, acidity of some nebulised solutions (pH<5.5), and possible presence of gastroesophageal reflux disease, which show the erosive effect. On the other hand, Dugmore and Rock[19] showed no differences in prevalence of dental erosions between asthmatic and healthy children.

Respiratory disorders may also be associated with enamel developmental defects. Guergolette *et al.*[20] reported higher prevalence of enamel defects in asthmatic than in healthy children with demarcated diffused opacities being the most prevalent. Since ameloblasts are highly sensitive to the lack of oxygen, authors assumed that enamel defects are attributable to the episodes of hypoxemia during amelogenesis.

Chronic therapy with ICS, oral dryness due to mouth breathing, and proinflammatory cytokine release in persistent asthma have been related to greater incidence of gingivitis in asthmatic patients[9,21,22]. Children with allergic asthma phenotype frequently have associated allergic rhinitis, manifested with various degree of nasal obstruction. Partial nasal obstruction and reduced nasal clearance may cause pronounced mouth breathing with reduced salivary flow. This leads to subsequent bigger accumulation of dental plaque[23]. McDeera *et al.*[22] showed raised prevalence of dental calculus in asthmatic children which can be contributed to the increased concentrations of salivary calcium and phosphate ions[24].

Asthmatic children, especially those with associated allergic rhinitis, may have facial dysmorhism with increased facial height, higher palatal vaults, overjets and posterior crossbites[25,26]. It is probably caused by difficulty breathing, preferable mouth breathing due to nasal obstruction and diminished respiratory reserve in those patients with severe airway obstruction.

From the above, it is clear that attitudes about the oral health of children with asthma are not consistent. Some epidemiological and clinical studies showed no relationship between asthma and oral diseases, while other studies demonstrated an increased risk for oral diseases in asthmatic patients. However, authors suggesting increased incidence of caries, gingivitis, candidiasis, tooth erosion, changes in the salivary flow and composition, etc. emphasized difficulties in finding the exact reason for higher prevalence of oral diseases in children with asthma[27-29]. One of the possible

explanations for the differences between the studies may be the nonhomogeneity of the samples, i.e. severity of the disease and specificity of the inhalation drugs used by the subjects in diverse studies.

Cystic Fibrosis

CF is the most common autosomal-recessive disease in Caucasians, with an incidence of 1:1.700-1:40.000 newborns. It is caused by a mutation in a gene located in the long arm of chromosome 7, coding for the complex protein called cystic fibrosis transmembrane regulator (CFTR). The main function of CFTR is transepithelial chloride transport. In case of nonfunctional ion membrane transport, secretions in the exocrine glands (including salivary glands) become thick and dehydrated. This results in systemic illness with dominant obstructive, suppurative lung disease that leads to diffuse bronchiectasis and chronic respiratory insufficiency as a main cause of dead. In most of the cases, CF patients also have maldigestion due to exocrine pancreatic insufficiency that leads to malnutrition which correlates to unfavourable outcome. In the last decades, there have been numerous improvements in early diagnosis and different treatment modalities, including lung transplant, with increased life expectancy and quality of life in patients with CF[30,31]. Therapy consists of high-calorie diet, pancreatic enzyme replacement therapy (PERT), fat soluble vitamins supplementation and medications that lead to increased mucus clearance (bronchodilators, mucolytics). In addition, patients are treated with inhaled and systemic antibiotic therapy in order to control chronic bacterial colonization in lower airways or treat exacerbation of suppurative lung disease.

Children and adolescents with CF are thought to be at an increased risk for oral diseases. This was thought to be related to the high calorie diet with frequent in-between sugar-rich meals, which may contribute to the high caries risk[32,33]. In order to preserve lung function and increase mucociliary clearance, inchalatory bronchodilators are used regularly, which may reduce salivary flow[34]. However, the results of numerous studies showed that children with CF have significantly lower incidence of caries[35-40] and better gingival health[32,41,42] when compared to healthy peers. It has also been shown that the incidence of dental caries in the primary dentition was lower in children with CF in comparison with children with other chronic respiratory diseases[43]. One of the explanations could be that CF patients probably maintain better oral hygiene to prevent spread of oral infections into the lungs[33], but better oral hygiene habits were not confirmed[32,40]. It has also been suggested that CF patients have significantly higher salivary pH and buffering capacity[37] which may act as a compensatory mechanism and contribute to the lower caries profile. It is most likely that the chronic use of antibiotics reduces the incidence of caries in children with CF. Early eradication strategies of initial bacterial infection or chronic colonization of lower airways in infancy and childhood (mostly *Staphylococcus aureus*), consists of chronic use of β-lactam antibiotics. It may also reduce cariogenic flora, i.e. *Streptococcus mutans* which is susceptible to β-lactams[33,39,40], and decreases plaque pathogenicity[32]. Over the ages, predominant pathogen in CF lungs becomes *Pseudomonas aeruginosa*. Usual therapies are chronic treatments with inhaled tobramycin or colomycin, which are not effective against *Streptococcus mutans*. Therefore, adolescents and adults may lose protection against caries[40].

Increased salivary pH and higher concentration of calcium in saliva may result in increased calculus formation[37]. The prevalence of dental calculus formation was not found to be significantly different between children with CF and other chronic respiratory diseases[43].

Children with CF may have dental maturation delay and higher risk for development of systemic enamel defects[44]. It was speculated that this was probably caused by metabolic and nutritional disorders and frequent use of antibiotics, which can have influence on teeth development[42]. Ferrazzano *et al*.[42] found enamel defects in 55.6% of CF patients, while they were present in 22.7% of healthy persons. In addition, more severe enamel defects with hypoplasia and partial loss of enamel had been noted in the CF group. Azevedo *et al*.[45] showed no difference in occurrence of lesions on deciduous teeth, but enamel defects on permanent teeth were more prevalent in CF children than in healthy controls. High prevalence of tetracycline discolorations associated with frequent use of these drugs in the past[35,36] is not common nowadays.

One of less frequent indicators of current malpractice in CF treatment is an inadequate administration of PERT, which happen because of improper use of product that is commercially available. Exocrine pancreatic insufficiency is clinically manifested by symptoms of maldigestion (greasy stools, flatulation, abdominal pain, rectal prolapses) when residual pancreatic function is <10%. Mainly of porcine origin, enteric-coated microsphere preparations were designed to avoid inactivation by acidic environment in the stomach. It dissolves in the duodenum when pH becomes alkaline. In case of crushing or chewing of microspheres in the mouth, severe oral lesions may appear and, in addition, symptoms of maldigestion persist. Irritation of the oral mucosa may be avoided by swallowing and not chewing the medications, or mixing them in foods[46].

Conclusions

Children with CRD may have higher prevalence of oral diseases influenced by numerous contributing factors in compare to healthy peers. Dental practitioners should be more informed about risk factors and specificities of

oral health in these patients. Patients and their parents should be educated about importance of oral health and possible severe general health consequences in case of presence of oral diseases or its complications. It seems that the occurrence of oral changes could be influenced by improper use of inhalation and PER therapy. Therefore, it is important to educate children and their parents on the proper use of these medicines. Although strict clinical protocols for the prevention of oral diseases in patients with CRD have not been defined so far, it would be of great importance if general paediatricians and pulmonologists would be aware of importance of good oral health suggesting regular dental examinations every three months. Preventive measures, early diagnosis and effective treatment strategies can reduce occurrence of oral diseases and make their complications less frequent which all may have significant impact on possible co-morbidities and patient's quality of life.

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