Assessment of dental status and oral hygiene in the study population of cystic fibrosis patients in the Podlasie province

Dąbrowska E[1]*, Błahuszewska K[2], Minarowska A[3], Kaczmarski M[3], Niedźwiecka-Andrzejewicz I[2], Stokowska W[2]

[1] Department of Social and Preventive Dentistry, Medical University of Białystok, Poland
[2] Department of Conservative Dentistry, Medical University of Białystok, Poland
[3] Department of Pediatrics, Medical University of Białystok, Poland

Abstract

Purpose: Cystic fibrosis (CF) is one of the most common genetic diseases worldwide. It is caused by mutations of the gene situated on the long-arm of the 7th chromosome coding *Cystic* Fibrosis Transmembrane Conductance Regulator (CFTCR) which is responsible for the synthesis of cAMP--dependent membrane chloride channel located on the top surface of epithelial cells of exocrine glands. Accumulation of the secretion in the outlet ducts caused by a dysfunction or lack of CFTR proteins leads to abnormal activity of exocrine glands, especially in the respiratory and alimentary tracts. Carbohydrates, the main dietary component, supply energy to the body, but at the same time are the major cariogenic agent. The aim of the current study was to assess dental caries disease and oral hygiene in CF patients in the region of Podlasie.

Material and methods: The study involved 23 patients with cystic fibrosis, aged 2.5-24 years, from the Podlasie Province treated in the Outpatient Cystic Fibrosis Department of the Children's University Hospital in Białystok. Three age groups were distinguished: 1-5, 6-12, 13-24 years. The following were evaluated: caries incidence (percentage of patients with caries CI), caries intensity – based on the mean dmf/DMF score, oral hygiene – based on the dental plaque index (OHI-pl).

Results: The incidence rate of caries was found to be very high both in the CF population and in the control group. In children with mixed dentition it was 100%. For permanent teeth, mean DMF score was 3.55 in group II and 10.9 in group III. In CF patients, dental plaque index was the highest in group III.

Conclusions: In CF patients, there is a serious risk of caries due to severe course of the disease, long-term administration of medications and high carbohydrate diet. CF patients should remain under constant dental care according to the individually designed programmes of oral health promotion and caries prophylaxis.

Key words: dental status, oral hygiene, cystic fibrosis.

Introduction

Cystic fibrosis (CF) is one of the most common genetic diseases worldwide. It is caused by mutations of the gene situated on the long arm of the 7th chromosome coding Cystic Fibrosis Transmembrane Conductance Regulator (CFTCR) which is responsible for the synthesis of cAMP-dependent membrane chloride channel located on the top surface of epithelial cells of exocrine glands [1]. A dysfunction or lack of CFTR proteins leads to disorders in Cl^- transport through cell membranes and increased Na+ and water absorption, resulting in the formation of dense and sticky secretion. Accumulation of the secretion in the outlet ducts leads to abnormal activity of exocrine glands, especially in the respiratory and alimentary tracts [2].

It is estimated that in Poland (like in most European countries) cystic fibrosis occurs in 1/2500 newborns and every 25th person is a carrier of abnormal CFTR gene, responsible for the disease. In the classic form (fully symptomatic), cystic fibrosis patients present with predisposition to bronchitis and pneumonia, failure of the exocrine part of the pancreas, male infertility and elevated sweat chlorine concentration [3,4]. Respiratory pathologies frequently determine the quality and length of life. Carbohydrates, the main dietary component, supply energy to the body, but at the same time are the major cariogenic agent.

* CORRESPONDING AUTHOR:
Department of Social and Preventive Dentistry
Medical University of Białystok
ul. Akademicka 3, 15-089 Białystok,
Tel. +48 085 748 57 95; fax: +48 085 748 57 96
e-mail: helpdentamb@tlen.pl

Received 02.03.2006 Accepted 13.03.2006

***Table 1*. Incidence of caries in the groups (CI)**

Study subjects		Number of subjects with caries			
		CF patients		Control group	
		n	%	n	%
Number of subjects aged 2.5-5 years with deciduous dentition	4	2	50	2	50
Number of subjects aged 6-12 years with mixed dentition	9	9	100	6	66
Number of subjects aged 13-24 years with permanent dentition	10	9	90	9	90
Overall	23	20	87	17	74

***Table 2*. Mean dmf in deciduous dentition in the study groups**

Group I	Number of subjects (n)		Mean dmf and its respective elements			
			d	m	f	dmf
Deciduous dentition	4	CF patients	3.25	0	0	3.25
	4	Control group	2.75	0	0	2.75

Legend: dmf – mean dmf score in deciduous teeth; d – mean number of deciduous teeth with active caries, m – mean number of deciduous teeth extracted due to caries, f – mean number of filled deciduous teeth

***Table 3*. Mean dmf/DMF score in mixed dentition in the study groups**

Group II	Number of subjects		Mean dmf + DMF and its respective elements										
			D	d	D+d	M	m	M+m	F	f	F+f	DMF	dmf	DMF+dmf
Mixed dentition	9	CF patients	2.33	1.77	4.11	0	0.55	0.55	1.22	0.11	1.33	3.55	2.44	5.99
	9	Controlgroup	0.22	1.22	1.44	0	0.44	0.44	0.55	2.11	2.66	0.77	1.77	2.54

Legend: dmf+DMF – mean dmf+DMF score in mixed dentition, d; D – mean number of teeth with active caries; d – deciduous teeth; D – permanent teeth, m; M – mean number of teeth extracted due to caries, m – deciduous teeth; M – permanent teeth; f,F – mean number of filled teeth; f – deciduous teeth, F – permanent teeth

This may suggest that CF patients are particularly susceptible to dental caries.

The aim of the current study was to assess dental caries disease and oral hygiene in CF patients in the region of Podlasie.

Material and methods

The study involved 23 patients with cystic fibrosis, aged 2.5-24 years, from the Podlasie Province treated in the Outpatient Cystic Fibrosis Department of the Children's University Hospital in Białystok. Three age groups were distinguished: 1-5, 6-12, 13-24 years, based on dentistry literature data and taking dentition type into consideration (deciduous dentition group I, mixed dentition group II, permanent dentition group III). The control group consisted of 23 healthy subjects randomly chosen out of those admitted to the Specialist Dental Clinic, Medical University of Białystok. Each CF patient was matched by age and gender to a control subject. The patients underwent a routine dental examination in artificial light, using a probe and a mirror. The methods used were consistent with the World Health Organization guidelines. Oral hygiene was checked after prestaining of the plaque with Red Cote tablets, Butler. The patients' parents gave their consent for dental examination.

The following were evaluated:

– caries incidence (percentage of patients with caries CI)
– caries intensity – based on the mean dmf/DMF score
– oral hygiene – based on the dental plaque index (OHI-pl according to Green and Vermillion)

Results

The incidence rate of caries was found to be very high both in the CF population and in the control group (*Tab. 1*). In the deciduous dentition group, the incidence rate reached 50% in CF and control children. In children with mixed dentition it was 100% (66% in control) and in children and adolescents with permanent teeth it was 90% (like in control). Only 3 CF patients and 6 healthy subjects were not affected by caries.

The intensity of the caries disease process was expressed as the mean dmf/DMF score (*Tab. 2*, *3*, *4*), which determines caries intensity for all subjects, not only those with caries. For CF patients, mean dmf was 3.25 in group I (deciduous dentition) and 2.44 in group II (mixed dentition). For permanent teeth, mean DMF score was 3.55 in group II and 10.9 in group III, thus being lower than in healthy subjects.

In CF patients (*Tab. 5*), dental plaque index was the highest in group III (1.28). It was lower in mixed dentition patients (0.5), while in patients with deciduous dentition the plaque was not present. Slightly higher values of OHI-pl were noted for the respective control groups.

Table 4. **Mean DMF in permanent dentition in the study groups**

Group III	Number of subjects (n)		Mean DMF and its respective elements			
			D	M	F	DMF
Permanent dentition	10	CF patients	5.8	0.1	5	10.9
	10	Control group	5.5	0.3	7	12.8

Legend: D – mean number of permanent teeth with active caries; M – mean number of teeth extracted due to caries; F – mean number of filled permanent teeth; DMF – mean DMF score in permanent dentition

Table 5. **Oral hygiene index (OHI- pl) according to Green and Vermillion in the study groups**

CF patients	Number of subjects	OHI-pl	OHI-pl			
			<1		≥1	
			n	%	n	
I	4	0	0	0	0	0
II	9	0.55	7	77.77	2	22.23
III	10	1.28	4	40	6	60
Control group						
I	4	0.99	1	25	3	75
II	9	0.81	6	66.66	3	33.34
III	10	1.31	4	40	6	60

Legend: n – number of the study subjects; OHI pl – oral hygiene index (plaque) according to Green and Vermillion

Discussion

Due to its common incidence, dental caries belongs to social diseases. Its main etiological factor is the bacteria most frequently transmitted by parents or caretakers in the early childhood [5]. Carbohydrates provided to the oral cavity together with food are the medium for cariogenic bacteria. As CF patients receive high carbohydrate diet, it is assumed that the cariogenic process can be more intensified in this group of patients. Various species of bacteria break down saccharides to acids, which leads to enamel demineralization and cavity formation. When oral hygiene is insufficient, dental deposits undergo mineralization and being transformed into dental calculus cause parodontosis [6]. CF patients, burdened with numerous ailments from many organs, receive various medications which affect the quality and quantity of saliva secretion [7]. Moreover, their potential cariogenic effect on teeth is increased by sweeteners added to drugs to improve taste [8]. Inhalers contain steroids which after long-term administration may cause oral mycosis, just like antibiotics taken in great amounts. Due to frequent infections of the upper respiratory tract, CF patients often breathe through the mouth, which promotes malocclusions and predisposes to periodontitis and inflammation of oral mucosa. The incidence of caries in the study population of CF patients in the Podlasie Province was high and in most cases comparable to the data reported by Olejniczak et al. for the study population in Poland [9,10]. Consistent with our results was higher caries incidence rate found within the age ranges of 6-12 and 13-24 years in CF patients, as compared to the controls. However, in our study, in the age range of 2.5-5 years, the incidence rate in CF patients was similar to that noted in healthy subjects. A comparison of caries incidence between patients with cystic fibrosis and cow milk intolerance, which is also manifested in malabsorption of nutrients, is more favorable for CF patients. Caries incidence was higher in children with food intolerance both for deciduous and permanent teeth (fp=88.50% i FP=95.20%, respectively) [11]. This may be caused by medications taken and a different type of diet, particularly in the period of maturation. Similarly to other authors, we found lower caries intensity expressed in mean DMF score only in CF patients aged 13-24 years, as compared to the control group [12-14]. Also in the study conducted by Olejniczak et al. on the Polish population, the p/P component for each study group in Podlasie was higher in CF patients than in the respective control group, being the highest in group III=5.8, with a lower mean DMF for these patients compared to healthy subjects [9]. Vitamin and micro- and macroelement therapy instituted in CF patients strengthens enamel and thus makes it more resistant to the caries process. Digestive enzymes taken by CF patients have a beneficial effect on saliva buffer capabilities [15], creating better conditions for the oral ecosystem. CF patients had higher concentrations of calcium, phosphate and potassium ions [16], increased pH of the saliva and greater buffer capacity [17], which suggests a simultaneous effect of these parameters on the reduction in caries intensity in CF patients.

Long-term antibiotic therapy in CF patients may inhibit the quantity of cariogenic bacteria in the oral cavity [15,18], the assumption confirmed by the mean DMF value for this group and a smaller predisposition to periodontitis. In the clinical study on the Podlasie population, like in other studies conducted in Poland and Belgium, CF patients demonstrated better clinical condition of periodontal tissues than healthy subjects, i.e. smaller bleeding from the gums and less or no dental calculus [1,8,10]. This is confirmed by lower values of oral hygiene index OHI-pl noted in the present study, despite poor awareness of the patients and their caretakers concerning oral ailments, observed in the accompanying surveys.

Conclusions

1. In CF patients, there is a serious risk of caries due to severe course of the disease, long-term administration of medications and high carbohydrate diet.

2. CF patients should remain under constant dental care according to the individually designed programmes of oral health promotion and caries prophylaxis.

References

1. Arquit CK, Boyd C, Wright JT. Cystic fibrosis transmembrane regulator gene (CFTR) is associated with abnormal enamel formation. J Dent Res, 2002; 81: 492.

2. Kostuch M, Wojcierowski J. Mukowiscydoza. Klin Pediatr, 1996; 4: 69-73.

3. Pogorzelski A, Żebrak J. Zasady rozpoznawania mukowiscydozy. Klin Pediatr, 1998; 6: 17-20.

4. Olejniczak M, Emerich K, Wierchoła B, Adamowicz-Klepalska B. Cystic fibrosis – an interdisciplinary medical and dental problem – on the basis of the literature. Czas Stomat, 2005; 58: 635-43.

5. Caufield PW, Griffen AL. Dental caries. An infectious and transmissible disease. Pediatr Clin North Am, 2000; 47; 1001-19.

6. Kaczmarek U. Mechanizmy kariostatyczne fluoru (The cariostatic mechanisms of fluoride). Czas Stomat, 2005; 58: 404-13.

7. Jaskowska E, Witmanowski H. Nieswoiste mechanizmy obronne śliny – przegląd doniesień. Czas Stomat, 2005; 58: 37-43

8. Aps JK, Van Maele GO, Martens LC. Caries experience and oral cleanliness in cystic fibrosis homozygotes and heterozygotes. Oral Surg Oral Med Oral Oathol Oral Radiol Endod, 2002; 93: 560-3.

9. Olejniczak M, Wierchoła B, Emerich-Poplatek K, Adamowicz-Klepalska B. Oral cavity ecology with respekt to dental status and dental treatment needs in examined population of patients suffering from cystic fibrosis. Dent Med Probl, 2003; 40: 337-47.

10. Olejniczak M, Emerich-Poplatek K, Wierchoła B, Adamowicz-Klepalska B. Periodontal status and periodontal treatment needs among patients suffering from cystic fibrosis. Dent Med Prob, 2004; 41: 461-7.

11. Andrzejewicz I, Stokowska W, Kaczmarski M. Wstępna ocean uzębienia dzieci z nadwrażliwością na pokarmy. Pediatria Polska supl. 6, 1999; 105-6.

12. Aps JK, Van Maele GO, Martens LC. Oral hygiene habits and oral health in cystic fibrosis. Eur J Peadiatr Dent, 2002; 3: 181-7.

13. Jagels AE, Sweeney EA. Oral health of patients with cystic fibrosis and their siblings. J Dent Res, 1976; 55: 991-6.

14. Narang A, Maguire A, Nunn JH, Bush A. Oral health and related factors in cystic fibrosis and other chronic respiratory disorders. Arch Dis Child, 2003: 88: 702-7.

15. Kinirons MJ. The effect of antibiotic therapy on the oral health of cystic fibrosis children. Int J Paediatr Dent, 1992; 2: 139-43.

16. Sorscher EJ, Breslow JL. Cystic fibrosis. a disorder of calcium-stimulated secretion and transepithelial sodium transport? Lancet, 1982; 13: 368-70.

17. Kinirons M. Dental health of children with cystic fibrosis; an interim report. J Paediatr Dent, 1985; 1: 3-7.

18. Aps J, Val Maele G, Claeys G, Martens L. Mutans Streptococci, Lactobacilli and caries experience in cystic fibrosis homozygotes, heterozygotes and healthy controls. Caries Res, 2001; 35: 407-19.