GENETIC ASPECTS OF DENTAL CARIES IN DENTISTS' PRACTICAL WORK

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Summary. The paper analyses dental caries (*Caries dentis*) in children, first detected after the eruption of teeth, manifested as dental cavities. Dental caries is considered as a poly-etiological disease. To understand the mechanism of caries development it is important to distinguish between environmental and hereditary factors. Current views of paediatric dentistry concerning the impact of hereditary factors on tooth resistance to dental caries gave rise to studies and considerations of genetic aspects that help resolve issues involved in dental caries prevention and treatment in dental practice. This led to the search for means of early prevention and treatment in the form of individual sets of strategies for treatment and prevention from prenatal period of child development and during early childhood: for children up to 3 years and with mandatory introduction of counselling and examination in medical genetic centres for expectant mothers and children having symptoms and risks of pathology of the primary and permanent teeth.

Key words: dentistry, caries, genetics, prevention, teeth, children.

INTRODUCTION

Dental caries is a major problem in modern dentistry that WHO emphasized and included into the six diseases of our time, prevention of which is the most important problem of medical theory and practice [5]. According to WHO, more than 90% of the world population are affected by caries and that tends to increase, especially among children [2, 5]. The consequences of caries lead not only to the destruction of the dental apparatus, inflammation of maxillo-facial area, but also to diseases of the ears, nose and throat (ENT organs), cardiovascular system, rheumatism, musculoskeletal system, kidneys, eyes, skin, etc. [6]. In children, the first signs of dental caries appear during the eruption of primary teeth and analysis of prevalence rate of dental caries in children suggests that, instead of the previous idea that tooth decay occurs rarely among children under the age of 3 years modern data show (O. Minchenya, 2000, L.Homenko, 2001, O. Grish, 2004, etc.) that caries is detected in 62.6% of children from 1-1.5 to 2 years old and among 70.3% - 85.5% of 3-year old children. The number of carious teeth in a child, as well as the number of cavities in a tooth, time of appearance vary and depend on many factors. Therefore paediatric dentistry, as an area of medical service, should take care of children's teeth continuously.

However, progress in medical sciences has spoken for relative increase in genetically caused diseases and has enhanced interest in the study of "genetic diseases" in recent years (V. Pusyrev, 2002; R.Bohatyryova, Ye. Grechanina, 2003; V. Demin, 2005; G.F. Hoffman, 2002 and others). Published data on heredity in dentistry are not numerous but contradictory. In addition, there are several theories of dental caries that have been developed in the last century, e.g. Miller's chemical-parasitic theory of dental caries (1884), physical and chemical theory of caries by J. Entin (1928), biological theory by I.Lukomskiy (1948), A.Sharpenak's theory (1949), proteolysis-chelation theory by A. Schatz and J. Martin (1956) or neuro-trophic theory of Ye. Platonov [1, 4].

Dental diseases are now understood through the concept of leading importance of endogenous factors in pathological mechanisms of their

development and their dependence on intrauterine foetal conditions (L. Persin, 1995; V. Yelizarova, T. Smirnova, 1998). The features of somatic status of children with genetic disorders made researches study caries prevalence rate and identify the risk factors of major dental diseases in this category of patients [2, 5]. Thus, practical work of modern dentists requires cooperation of dentists and geneticists, whose attention is directed to the study of genetic aspects of dental caries in early age children, in addition to prevention and treatment. Today, a large arsenal of means and methods of treatment and prevention of oral diseases has been developed, the most important of them is prevention of children's dental diseases, but preventive measures in children over the first three years of life have not been executed sufficiently. Therefore, paediatric dentistry emphasizes the development and implementation of modern endogenous and exogenous caries prevention methods in early age children is a necessary precondition of normal development. Data on the clinical features of hereditary abnormalities of the mouth, their dental manifestations are hardly found, but they are required to choose correct treatment and prevention of caries in early childhood. Shortage of timely applied preventive and treatment methods of dental caries leads to premature tooth loss and premature aging of an organism as a whole.

The aim of the research was to study the causes of dental caries and their prevention and treatment, both in primary and permanent teeth in early age children.

ANALYSIS OF THE PROBLEM

Dental caries is a ongoing chronic process, which is the source of infection and development of allergies in a child because an eating child swallows permanently a large number of micro-organisms in addition to tooth tissue decomposition products and food trapped in cavities. Therefore, prevention of dental caries should begin as early as in the prenatal period and continued throughout entire life. For now, more than 4,500 genetic diseases have been described and 5% children are born with hereditary or congenital disorders. It is very important for a dentist to know dental manifestations of hereditary diseases and syndromes. The analysis of genetic diseases of different genetic structure and the study of their prevalence have become a part of dental practice. For this reason, dental practice should:

- examine the role of heredity in oral pathologies;
- investigate a number and variety of chromosomal changes in oral pathologies;
- research into changing of dentition because of hereditary diseases;
- analyze monogenic syndromes characterized by changes in facial bones and cerebral cranium and syndromes in hereditary abnormalities [6].

It turns out that dentists in cooperation with geneticists should study the primary nature and consequences of genetic factors involved in caries in early age children. There are a number of diseases in dentistry that are considered as congenital malformations and as such require surgical, therapeutic, i.e. complex interventions: non-closure of the hard and soft palate, aedentia, hipodentiya, diastema, abnormalities of enamel and dentin structure whose heredity is considered to be well-established [4]. Cranio-facial abnormalities, including morphological changes in teeth can be caused by chromosomal aberrations, gene mutations and combined influence of many genetic and environmental factors. Such multi-factor diseases constitute the most common group of genetic disorders and birth defects [6]. Since disease prevention is much simpler and easier than treatment, prevention of dental diseases, including correction of birth defects, has occupied a large place in dental practice for a long time.

Thus, due to wide prevalence of dental caries and rapid development of complications, caries prevention should be started from the prenatal period of child development, i.e. before child's birth, and continued throughout his/her childhood: in children under 3 (early childhood) years of age, and preschool and school-age children.

When a unified theory of caries does not exist, numerous factors are said to be involved in tooth decay. According to modern concepts of dental caries aetiology, the recognized mechanism of dental caries is progressive resistance and demineralization of dental hard tissues under the influence of organic acids formed by microbial activity. According to V.Antonenko (2000), F. Ayala, J. Kiger (1987), O.Yanushevych A. (2009) caries process is caused by many factors: etiological (oral micro-flora; diet characteristics, fluoride content in water, quantity and quality of saliva, overall health, extreme influence on a body, etc.), general (inadequate diet and drinking water, physical illness and changes in functional states of

organs and systems during tissue formation and maturation, extreme influences on a body, heredity and unfavourable genetic code, etc.) and local (dental plaque, dental deposit, abnormalities of composition and properties of oral fluid, resistance of dental tissue, abnormalities in biochemical composition of dental hard tissues, inadequate structure of dental tissues, state of dentition during germ development and eruption of permanent teeth, etc.). Thus dental caries is considered as poly-etiologic disease [1, 4]. Criogenic factors responsible for tooth decay can be divided into general and local, can be of varying intensity and character; thus different modes of their interactions contribute to developing dental caries. However, to understand the mechanism of tooth decay it is important to distinguish between external and hereditary factors so that preventive measures can adequately match their different nature.

For successful dental prophylaxis, it is important to know that teeth development starts in the embryonic period and is completed at the age of 18-20 years. The formation of dental germs, their differentiation and histogenesis and calcification of hard tissues take place during germ laying and in-jaw formation of teeth. The first signs of teeth appear in 6-7 week of embryogenesis. The important moment of the stage of dental germ differentiation is bending of inner enamel epithelium that determines the shape of the future crown. It is at this stage (L. Khomenko, 2001) that the impact of various factors leads to crown defects. Mineralization of primary teeth starts from the maxillary central incisors in 4th month of prenatal period. Mineralization of permanent teeth starts form 1 molar of the maxilla closer to birth [7]. This fact puts some teeth in much more favourable conditions for the formation of resistant enamel in comparison with other teeth. Thus, the incisors, canines and first molars, whose histogenesis takes place during foetal life, are protected by mother's body. During this period, genetic factors manifest themselves most visibly in organ structure formation; even the smallest disorders are possible under the influence of unfavourable factors. Disorders in organ structure formation, including teeth are possible only under very strong influence on the foetus. From our point of view, the onset of mineralization is very important, too. For the first molar, it occurs in 9 month uterine development. This is the most unfavourable time since it coincides with birth and first months of life. Beginning of mineralization of incisors and canines occurs in later period (6-9 months of age), when newborn's body adapts to environment. Perhaps this unequal situation for different periods of histogenesis, especially, periods of mineralization of incisors, canines and first molars can explain the formation of tooth enamel on the first molar which is less resistant to caries. However, diseases during neonatal period (haemolytic disease, dyspepsia, etc.), antibiotics, premature delivery often lead to the formation of enamel which is less resistant to caries, primarily, of the first molars. The place a tooth occupies in the dental arch is also important. The first molar is located where self-cleaning is complicated compared to incisors and canines. Therefore, during pregnancy, an unborn child should receive all nutrients necessary for healthy teeth. To be healthy, children's teeth and bones need calcium. Calcium comes from the food eaten by his/her mother and is stored in her bones. Diet of a pregnant woman should include a wide range of proteins (primarily of plant origin), carbohydrates and fats. It should be noted that pregnant women should refrain from treatment with tetracycline because it binds with calcium and gets embedded into teeth, giving them green or brown colour (co-called tetracycline teeth) [4, 7].

Studying gene groups responsible for pathogenic mechanisms of caries, researchers hypothesized the influence of heredity on tooth resistance to dental caries. This made it possible to assume that a genetic system that determines the resistance to dental caries involves more than one gene. One (main) gene controls the possibility of developing that trait; it is probably recessive in relation to the gene that determines susceptibility to caries [1].

Thus, a direct correlation exists between the prevalence rate and intensity of children's caries due to the influence of heredity on tooth constitution and its susceptibility to tooth decay. That can result from abnormal course of pregnancy or diseases during pregnancy because primary teeth are germen in the prenatal period, i.e. when a child is still in the mother's body.

Many professionals such as dentists and geneticists from around the world suggest clinical examination of families whose members have a high level of caries. Since heredity affects both resistance to dental caries and susceptibility to carious process, severity of which is genetically determined, thus, primary tooth caries prevention should begin as early as during intrauterine development and the earlier risk factors are

identified, eliminated or weakened, the lesser development of caries is observed in a child after his/her birth.

Speaking about caries development (T. Kharitonova, S. Lebedeva, L. Kazakova, 2011) in children after birth, taking into account modern concept of dental caries aetiology, the authors state that caries is a bacterial infection that now has become a pandemic (that is prevalent in all countries) and flourishes in favourable conditions when general and local resistance of the body is reduced [7]. However, in accordance with known biogenetic law of Haeckel-Müller, individual development - ontogeny - is recapitulation of phylogeny (evolutionary development) or, rather, of embryonic stages in the evolution of species. The order of eruption and change of primary and permanent teeth conforms to this law. Therefore, normal tooth eruption has strict sequence for every child, and there are average terms of eruption for each tooth with small natural variations into acceleration or delay. The terms and order of child's tooth eruption is a measure of his/her normal development. Large differences in real time of eruption from the point of view of the terms or order are often due to various hereditary diseases [1, 4].

CONCLUSION

Genetically conditioned dental caries is frequently met in dental practice. For early prevention and treatment, the introduction of mandate counselling and examination in a medical genetic centre should be provided for early age children and expectant mothers with the symptoms and risks of that pathology affecting primary and permanent teeth aside individually selected set of treatment and preventive measures.

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