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Cardiovascular diseases and oral health – the impact of pregnant women’s oral health on children’s cardiovascular health

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CHAPTER II
ORAL AND CARDIOVASCULAR HEALTH

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The correlation between oral health and cardiovascular diseases was evaluated in the past, but not the influence of mother's nutrition and oral health on the fetal cardiovascular development which can lead to:

- slow fetal growth,
- low birth weight,
- difference in the development of blood vessels

Pregnancy is a state during which the body undergoes complex physical and physiological changes that have important impact on multiple organs and systems.

Some authors suggest a possible link between periodontal disease in pregnant women and the risk of premature childbirth, low birth weight newborns and possible cardiovascular diseases.

Hence, the aim of this research, the results of which are presented in the following pages, is to evaluate the link between maternal oral health, their diet during the pregnancy with the development of coronary and carotid arteries and cardiovascular system.

The consideration of origin of the development of diseases of the cardiovascular system will start with a brief overview of the development of atherosclerosis.

Atherosclerosis

As a cardiovascular disease, atherosclerosis is a multifactorial in its etiopathogenesis and is treated by: family doctor, pediatrician, pediatric cardiologist, cardiologist, neurologist, diabetologist, endocrinologist, cardiovascular surgeon, neurosurgeon, radiologist, nuclear radiologist, epidemiologist, nutritionist, pathologist, and biochemist with the aim of early detection and

treatment of atherosclerosis and also minimizing the development of risk factors for coronary artery diseases.

Pathophysiology of atherosclerosis is characterized by the damaged cells located in the inner surface of the arteries where endothelium is exposed to chemical or mechanical injury.

Elevated blood cholesterol, smoking or elevated homocysteine (one of researched causes of atherosclerosis today) are some examples of chemical and mechanical cell injury as well as high blood pressure, injury caused by catheter during diagnostic procedures and even infections.

The first stage of atherosclerosis development occurs in the form of a "fatty streak".

Fatty streak is totally reversible, which means that endothelial cells can completely recover when harmful activities of pathogens are terminated. However, if harmful activities continue, atherosclerotic plaque grows and narrows lumen even further.

This results in inadequate blood flow and oxygen delivery to the tissues. In the blood vessel, itself due to reduced elasticity, an increase of blood pressure occurs. Elevated blood pressure can lead to rupture of the blood vessel or formation of aneurysms or plaque which can calcify and narrow down blood vessel walls and help form a blood clot.

Plaque composition is much more important than plaque size for atherosclerosis. *Subclinical atherosclerosis* is and early indicator of cardiovascular changes. It is very important and alarming since the process can be stabilized and reversed if treated in time.

Ultrasound measurements of carotid intima-media thickness cIMT is considered a valid surrogate marker for assessing cardiovascular risk, which allows the assessment of the atherosclerotic changes at an early stage.

Oral health

The association between oral health and atherosclerotic cardiovascular disease

Oral diseases are among the most common chronic noncommunicable diseases. Oral health is key indicator of well-being and quality of life and have close linkages with general health.

Periodontitis is progressive disease of tooth-supporting apparatus-*paradoncium* whose role is to support the tooth and keep it fixed to the bone. It includes: cementum, alveolar bone, periodontal ligament and gingival tissue.

If one of these elements is jeopardized, the whole apparatus begins to decay. It happens gradually which makes this a progressive disease. The cause of periodontitis are bacteria from dental plaque.

If not diagnosed and treated, periodontitis becomes chronic inflammatory, immune-driven disease, characterized by deterioration of periodontal ligament and alveolar bone.

Links between oral diseases and general health are multifaceted and complex.

Most oral diseases have common risk factors, including:

- unhealthy diet high in free sugars,
- tobacco use and
- excessive alcohol consumption by people with cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes mellitus.

Oral cavity is an integral part of human body and thus there is a link between oral and systemic health. There is reciprocity between periodontitis and some systemic diseases, such as diabetes, osteoporosis, HIV infection, and trisomy 21.

People with periodontitis are more prone to some systemic diseases than healthy people:

- chronic periodontitis is a risk factor for future cardiovascular diseases,
- pregnant women with chronic periodontitis are at a higher risk of preterm births and
- women give birth to low-birth-weight infants.

The explanation for the pathophysiological mechanisms *of periodontal focus and systemic disease* is linked to the increased level of circulating pro-inflammatory cytokines and prostaglandins derived from: periodontal disease, gram-negative bacteria and endotoxin-like substances that appear from subgingival biofilms directly entering the bloodstream.

Dominant problems of everyday dental practice are *caries, periodontal disease, occlusal abnormalities, the link between oral and general health and holistic approach to the patient.*

Caries and periodontal disease are of an infectious etiology, therefore the prevention of dental caries and periodontal disease means preventing odontogenic focuses.

A periodontal pocket is a risk factor for the development or worsening of systemic disease and focal infection because the infection is always present in it. The flora of periodontal pocket is diverse, massive, virulent and penetrates

the soft wall of the pocket. The pocket is under constant mechanical stimulation during chewing, swallowing and speech, and it all benefiting the penetration of bacteria into circulation and the formation of transient bacteremia.

Interdisciplinary cooperation in eliminating potential negative effects of periodontal infections will result in better systemic health.

Dental caries and periodontal disease are the most common and significant oral disease that can cause and aggravate numerous other disease:

- of the cardiovascular system (infective endocarditis, atherosclerosis,
- myocarditis, and myocardial infarction),
- of the respiratory system (pneumonia, chronic obstructive pulmonary disease, bronchial asthma, and pulmonary abscess),
- neurological disorders (cerebral infarction and cerebral abscess),
- diabetes mellitus, rheumatoid arthritis,
- Alzheimer's disease,
- complications of pregnancy (preeclampsia, stillbirth, miscarriage),
- preterm births and low birth weight,
- osteoporosis.

Pregnancy

Pregnancy is a state in which there are complex physical and physiological changes, which have important effects on multiple systems of organs. High levels of circulating estrogen during pregnancy are associated with high prevalence of gingivitis and gingival hyperplasia or certain forms of periodontal disease.

It is believed that approximately 40% of pregnant women have a certain form of periodontal disease. Offembacher et al. (1996) first suggested a possible link between periodontal disease and risks for child delivery of a low gestational age or small birth weight. Many researchers suggest a possible link between periodontal disease in pregnant women with a risk for preterm delivery, i.e., low birth weight. Researchers show that pregnant women with periodontal disease have 2-7 times higher risk for premature birth.

That is why dentists need to motivate, educate, and instruct pregnant women towards a higher level of oral hygiene and to repair all orodental lesions in dental therapeutic procedures, especially periodontal pockets, thereby reducing the number of premature births.

It is considered that genetic factors may be an important factor in developing periodontal disease. Scientists believe that DNA sequence variations

influence the individual risk for the development of periodontal disease because they have found that due to the variation of gene sequences, the activity of alpha defensins (antimicrobial peptides present in neutrophil granulocytes) which is responsible for the destruction of periodontopathogenic bacteria, could be stopped. Munz et al. discovered that gene loci linked with chronic and aggressive periodontal disease susceptibility is due to disorders in congenital and acquired immunity which leads to development of periodontal disease.

Prematurity

Incidence of premature births and low birth weight deliveries varies from 5% to 18% depending on the geographical area and characteristics of population.

Causes of premature births are believed to be unknown in 50% of cases, and other possible causes are: socio-economic factors, acute and chronic diseases, multiple pregnancies, gynecological causes, hereditary diseases, placental and other causes.

It is extremely important to identify *potential risk factors* of preterm birth because this can significantly decrease incidence of preterm birth and low birth weight deliveries which reduces perinatal mortality rate and potential perinatal complications.

Preterm infants and low birth weight infants are at increased risks of cardiovascular disease vs. full-term infants and normal birth weight infants.

Risk factors for prematurity are:

Prior premature birth, multiple pregnancies, uterine or cervical problems/ uterine infections, cervical insufficiency, placental abruption, chronic high blood pressure, preeclampsia, diabetes, smoking, alcohol use, age, lack of prenatal care, poor nutrition, untreated infection. Mothers who gave birth to preterm infants or low birth weight infants have significantly higher levels of PGE2 in gingival fluid as opposed to mothers who gave birth to full-term and normal birth weight infants.

During pregnancy there is an increased susceptibility to caries due to:

- increased acidity in the oral cavity,
- increased consumption of refined sugars and
- poor oral hygiene.

Caries in children is usually transmitted by direct transmission through the mother's saliva. Mothers with high level of Streptococcus mutans in their saliva are more likely to transmit the bacteria to their baby – by vertical transmission, creating conditions for the development of caries in early childhood.

Time and frequency of bacteria transmission, proneness to the accumulation of bacteria on child's teeth, saliva composition and flow, the amount of refined sugar in child's diet are all significant indicators of early childhood caries development.

Due to the immaturity of their organ systems, preterm and low birth weight infants belong to the vulnerable group of infants – preterm birth complications are the leading cause of death among children under five years of age. Preterm or low birth weight infants exhibit a higher incidence of cardiovascular risk factors (obesity, hypertension, dyslipidemia), and type 2 diabetes mellitus.

Animal and epidemiological studies indicate that elevated levels of glucocorticoids in utero are programming the hypothalamic-pituitary-adrenal axis during life which plays a key role in contributing to the higher occurrence of cardiovascular risk in preterm and low birth weight infants.

Apart from the role of oral microbiome (microbiome - all microbes, their genome and mutual interaction in particular environment) as a risk factor for preterm birth or low birth weight infant, it is possible that *microorganisms of the oral cavity during chronic inflammation can become an atherosclerotic risk factor for cardiovascular diseases.*

Appropriate prenatal health care should include oral health care of pregnant women. It is important to point out the importance of practicing regular oral hygiene and the need for regular dental check-ups.

Considerable number of pregnant women have inadequate oral health due to irregular visits to the dentist, poor oral hygiene, unhealthy diet and everything that might cause the occurrence of caries and periodontal disease in pregnant women.

The sufficient oral health screening of pregnant women is not carried out in daily work. Therefore, by reviewing the oral health status of larger number of pregnant women, including the assessment of their oral hygiene, we could timely identify pregnant women who have dental caries or periodontal disease.

Timely dental treatment could decrease occurrence of dental caries and periodontal disease in pregnant women and could reduce the rate of preterm delivery and low birth weight infants, early childhood caries and predictors

of early atherosclerotic cardiovascular risk (increased body mass index, blood pressure and carotid intima-media thickening).

In a group of children who were born prematurely or had low birth weight, a certain number of children aged 3 years have higher body mass index, higher systolic and diastolic blood pressure, as well as thickening of carotid artery intima-media complex with early signs of cardiovascular disease.

Insufficient insight into the possible pathological implications of the oral health status of pregnant women and their eating habits on premature expression of cardiovascular risk factors in children initiated this research.

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