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Systemic response of the primary infection foci localized in the oral cavity

Focal infection is a generalized systemic reaction that occurs and develops as a consequence of inflammatory-bacterial change localized in small restricted area that is in the primary focus. Primary focus is the source of bacterial, toxic, allergic or nervous action which causes or maintains pathologic changes. Potential primary infection foci are intradental (teeth with dead or mummified pulp, teeth with gangrenous pulp, teeth mistreated endodontically), extradental (foreign bodies left after endodontic treatment, periapical changes, cysts), left roots, retained teeth, periodontopathies, chronic ulcerations and inflammations of the mucous membrane (15).

As far back as antiquity a correlation was found between the diseases in the oral cavity and systemic diseases. Hipocrates described a patient with rheumatism whose health state improvement was stated after the extraction of gangrenous tooth. In the 19th century Miller, the professor of dentistry in Berlin, in his book "Microorganisms of Human Stoma" describes general diseases caused by inhalation or swallowing of the bacteria abiding in the oral cavity, he also recalls pathogenic influence of gingivitis (13, 15, 16). However, it was the appearance of an English doctor and pathologist William Hunter on 3rd October 1910 in Montreal which aroused interest and support in the world of medicine. Hunter presented cases of his own patients who experienced complete recovery or large improvement of general health state after the removal of supplements (he described them as "mausoleums on the masses of infection"). "Oral sepsis"– in this way Hunter described the influence of dental foci on the system. In the twenties of the 20th century pulpless teeth were extracted on enormous scale and even extraction of vital teeth was thought to be a way of prophylaxis against focal infection. Dental surgery developed, however, endodontics that was arising at that time was totally forgotten (13, 15). Billings (1912) considered the infection focus to be the main pathogenic agent in rheumatic diseases, and in the years 1910–1924 Rosenov in his bacteriological studies revealed that the foci in teeth and tonsils played an important part in the rise of the inflammation of muscles, joints, endocarditis, kidneys, numerous skin diseases and the nervous system. Infection foci were then considered to be main causes of diseases the etiologies of which could not be explained. In the United States in the thirties and forties teeth and tonsils were removed in large amounts, removal of tonsils was even recommended in every healthy individual. The reason for so radical behaviour was systemic infection of the organism having dental background which led to death one of American presidents of that time Theodore Roosevelt (16).

The following years were a continuous dialogue of both supporters and opponents of the theory of focal infection. In Poland the forerunner of the theory of focal infection was prof. Seweryn Gałęzowski who in 1829 described a case of 'fair blindness' which regressed after the removal of a gangrenous tooth. Fifty years later Teofil Kaczorowski (an internist from Poznań) cured himself of a long-term parenchymatous keratitis after the extraction of necrosed teeth (16). He was the first to use the expression "infection foci". In the years 1881–1884 he presented a number of lectures and publications and in the work "About the Cause–Effect Relationship between Gingivitis and Other Diseases" published in 1884 he revealed that there existed a close relationship between the

organic disease and the infection focus in the oral cavity. He wrote about the secondary foci being various diseases of the digestive, respiratory systems, diseases of the eye, skin as well as nervous and psychic disturbances. Moreover, he revealed in his own clinical material that many of the diseases regressed or patient's improvement was observed after the removal of "decaying teeth" (15, 16).

Although the theory of focal infection in relation to chronic inflammation of periapical tissues had been criticized lately, at the same time it widens the indications for endodontic treatment. It does not change the fact that pathological changes in patient's oral cavity may contribute to his general deterioration. The influence of parodontitis with deep gingival pouches on the formation of pathological changes localized diversely in the organism was proved on the basis of studies and clinical cases which were faced by the doctors. Below, examples of the systemic diseases will be presented. Their relation with infection foci in the oral cavity was proved thanks to the analysis of clinical cases.

Infectious endocarditis may be the consequence of the transmission of blood-borne microorganisms from the focus in the oral cavity. *Staphylococcus aureus*, *Streptococcus viridians*, *Streptococcus bovis*, *Enterococci* and Gram-positive and Gram-negative bacteria with HACEK group are chiefly responsible for endocarditis (7, 12, 17). Therefore, the use of prophylactic antibiotic therapy is so important in people in the risk group prior to dental surgeries which could evoke bacteraemia, e.g. before teeth extraction, procedures on the periodontium, endodontic treatment, insertion of implants, teeth replantation and others. According to the American Cardiology Society antibiotic cover is needed in (2).

Table 1

Recommended antibiotic therapy – large or moderate risk
• Past bacterial endocarditis
• Artificial valves of the heart
• Congenital heart diseases
• Acquired valvular heart disease
Recommended antibiotic therapy – small risk
• Relapse of a mitral valve without the regressive blood flow
• Past procedure of coronary artery bypass grafting
• Ventricular defect, Boatel's duct 6 months after the surgery
• Physiological and innocent heart murmur
• Pacemakers

The Society suggests the following doses of antibiotics for the use and prevention of the bacterial endocarditis:

Table 2

Standard prophylaxis	Ampicillin	2.0 mg 1 hour before the surgery
parenterally	Amoxicillin	2.0 mg i.m. or i.v. 30 min. before the surgery
	Clindamycin	0.6 g 1 h before the surgery
	Cefalexin or Cefadroxil	2.0 g 1 h before the surgery
	Azythromycin or Clarithromycin	0.5 g 1 h before the surgery
	Clindamycin	0.6 g i.v. 30 min. before the surgery
	Cefazoline	1.0 g i.m. or i.v. 30 min. before the surgery

Numerous studies recently reveal the correlation between inflammations in the oral cavity and the development of the diseases with thrombotic-embolic etiology. According to Bubiłek-Bogacz (3) the risk increases in people over 60 years of age. Matilla et al. (8) stated statistically essential increase of cases of myocardial infarctions in patients with periodontal diseases as well as Bergston (1) who noticed the correlation between myocardial infarction and the diseased periodontium.

The cause of pneumonias and aggravation of the chronic obturative pneumonia may also be found among primary foci in the oral cavity. Saliva aspiration leads to the transmission of bacterial antigen to the lower respiratory tract (9). Mojon underlines, that colonization of periodontium pathogens in the respiratory tract essentially increases the risk of the development of the chronic obturative lung disease as well as other diseases of the respiratory tract (9). It is confirmed by Haye's studies who stated the development of this disease 1.77 times more frequently in people with considerable resorption of the alveolar process (11, 14).

The frequency of occurrence of the rheumatoid arthritis (RA) in patients with periodontitis is 3.95%, whereas in people without any changes in the periodontium 0.65%. 62.5% patients with RA, though, had advanced periodontitis. Related etiopathy of these diseases is underlined: similarly we state the increased level of proinflammatory cytokines, low level of tissue inhibitors of metalloproteinases and the high level of metalloproteinases of the intercellular inhibitors, PG2 and inflammatory cells (11).

The primary focus inducing restricted nephritis may be the infection foci in the tonsils, teeth, periodontium. Żurek's studies reveal that patients with the foci in the oral cavity and throat are 3 times more inclined to have glomerulonephritis (19). He suggests that the development of Malkerson-Rosenthal syndrome is conditioned by genetic predispositions and allergenic action of the bacteria and toxins from intrasystemic infection foci, especially from the oral cavity, collateral nasal sinuses, and palatal tonsils (18). Metastatic abscesses in the vertebral canal and brain abscess have focal etiology (6, 7, 17). Purulent infiltration and even a small periodontal inflammation focus being the consequence of proliferation by means of continuity may be the starting point of inflammatory processes of soft tissues, maxillary bones, orbits (14). Blood borne infection may even reach cavernous sinus, meninges, brain, and spinal cord. According to Larkin, Szymaniak, and Teichmann dental and oropharyngeal septicaemia are primary sources of metastatic infections most frequently affecting the nervous system (7, 15, 17). In the article of Langowska-Adamczyk et al. we find a case of a nine-year-old boy who had metastatic abscess of the vertebral canal with flaccid paralysis of lower limbs. The infection foci were lower molars in the state of gangrenous decay and the inflammatory infiltration of soft tissues. The focus was not removed in proper time. The child was treated in children's and neurosurgical department with the symptoms of urine retention, mandible osteotitis. The result was flaccid paresis of lower limbs, secondary hypochromic anaemia, the destruction of coronoid and condyloid processes of the mandible, avian face and open bite (6).

Teichmann (17) conducted interesting studies and proved the relation of the occurrence of brain abscess and bacteraemia caused by the inflammation of teeth and periodontium. In 30% of the examined cases tooth was the cause of it. As Larkin (7) proved, bacteraemia after teeth extraction can also be the cause of perivertebral metastatic abscess and the paralysis of lower limbs. He described it basing on the case of 65-year-old patient who experienced such complications. Larkin proved that the main pathogens were microorganisms of dental origin: *Streptococcus pyogenes*, *Streptococcus salivarius*, *Staphylococcus aureus*, *Escherichia* coli, *Streptococcus mutans*.

It was revealed that mothers with advanced and generalized gingivitis are more likely to have preterm labour (e.g. before 37th week of pregnancy) and delivering a baby with low body weight (below 2500 g). The studies were conducted by Konopka on women population from Lower Silesia (5). Similar studies were conducted by Offenbacher (12), who proved that moderately advanced gingivitis creates a 7.5- times higher risk of preterm delivery which increases with women's age and duration of pregnancy. Mechanisms explaining interrelation between the preterm deliveries and periodontal diseases are the stimulation of the uterus by bacterial pathogens and their endotoxins for the production of proinflammatory cytokines (4, 12). The detection of the foci

of infection should not be difficult provided there is a thorough intra- and extra-oral clinical examination as well as radiological examination (panoramic X-ray pictures and teeth X-rays) (14). When taking patient's history we look for cause-effect relationship between the basic disease and infection foci. One has to find out whether the initiation or aggravation of the disease was preceded by the occurrence of odontogenic inflammations.

There are absolute indications for the removal of the foci in such diseases as: rheumatic fever, endocarditis and/or carditis, rheumatoid arthritis (early stage), obliterative thrombangiitis, states after past cardiosurgical procedures, acute, diffuse glomerulonephritis, diseases of the eye: acute and recurrent cycloiritis, retinitis, skin diseases: furunculosis, erythema exudativum multiforme, erythema nodosum, allergic dermatitis, urticaria or allergic reactions, states of periodic increase of temperature not justified by systemic disease, planned immunosuppressive treatment, before longer surgical procedures, planned sanatorium treatment. Relative indications include chronic diseases which caused irreversible anatomic-pathologic changes in the organs which are the secondary foci (15).

As far as absolute indications are concerned it is necessary to remove radically the infection focus as there is a chance for cure and prevention of the disease relapse. In relative indications we perform a selective removal or treatment of the infection foci (13, 15, 19). Then the examination of the so-called foci reactivity is then essential. We apply here provocation foci tests. As a result of irritation of latent foci with stimuli (pharmacological, antigenic, mechanical, electric) there is a short-term, reversible aggravation of the disease process. Acute diseases are the contraindication to the tests because the focus provocation may worsen patient's general state.

The following tests are worth to mention (13, 15):

Penicillin test – excluding patients allergic to penicillin. The test should be always preceded by allergic test. Test result can be read after 24 h. The test consists in intramuscular injection of 180–200 thousand units of prolonged activity penicillin. Tooth sensitivity to percussion, biting or the occurrence of idiopathic pain after 24 h are considered to be positive test result.

Histamine test – contraindicated in patients with bronchial asthma. The result can be read after 5–15 min. It consists in submucosal administration of 0.3 ml histamine dichydrochloride in the concentration of 1:1000 into the oral vestibule. Idiopathic pain or pain on teeth percussion or biting after 5–5 min. is considered to be a positive test result.

Antigen tests – e.g. Bottyan, K Ekogen according to Kostecki, Ganslmeyer's Antisepton, D. Spenglersan's tests. All antigen tests are most frequently accompanied by the symptoms of malaise, increased body temperature, aggravation of the secondary focus. Therefore, they are of a limited use in ambulant practice.

Standel's electric focal test (EFT) – the most frequently performed test in ambulatory. It consists in the irritation of the skin in the area of the mandible and maxilla with the alternating current of a low voltage using a brush moisted in the physiological solution of NaCl. Silent electrode is a metal rod wrapped in moist gauze, held by a patient in his hand. As a result of irritation within the range of the active reaction foci there is a skin reaction in the form of erythematous spots and hyperaesthesia.

The way of the foci removal depends on patient's age, placement and the type of the focus. It is a very complex problem and it requires cooperation of the dental surgeon and the doctor managing the patient (e.g. cardiologist, internist, paediatrician, ophthalmologist, rheumatologist, and oncologist). One cannot accept a uniform profile in the therapeutic management, however, there are certain obligatory rules. Treatment of a chronic disease should begin with the removal of the active infection foci (it should be remembered that it does not concern the period of disease aggravation). Decision concerning the method of removal of the detected active foci is up to the dentist – each case should be approached individually. A physician is obliged to consider correlation of the pathogenic factors (including infections in the oral cavity) and their influence on the development of the systemic diseases. Antibiotic prophylaxis should be remembered about in people in the risk group (in agreement with managing doctor). Moreover, in patients with chronic diseases with periodical remissions dental treatment should be planned in the periods of health state improvement (2, 10). Considering contemporary views concerning endodontic treatment of patients bur-

dened by general diseases one should be critical of the theory of the focal infection. Indications for endodontic treatment of patients burdened with general diseases were considerably widened. Contemporary endodontic manuals point out that the theory is speculative in character, it is not empirically confirmed and granulation changes are not generally infected with bacteria and they are subject to routine endodontic treatment (10).

Oncological patients are serious clinical problem. In case of planned radiotherapy within dentate parts of jaws it is necessary to remove all pulpless teeth and teeth possessing deep periodontal pockets from the exposed area (15). It prevents dangerous complications within the bone range which in time can be subject to osteonecrosis. In case of neoplasms affecting other parts of body, defining indications for the endodontic treatment should be preceded by the consultation with the managing doctor. Endodontic treatment in these patients absolutely requires preparation of the root canal in its whole length with particular regard to antisepsis rules. Special attention should be drawn to hygienic procedures and the use of antiseptic gargles (Chlorhexidine or Listerine) because of the decreased saliva production being frequent complication after radiotherapy or chemotherapy. We should be aware of the correlations between health of oral cavity and general diseases. For some people the existence of these correlations is obvious, for others it is doubtful and for many not direct but noteworthy.

Therefore, further studies are needed using the latest bacteriological techniques which will allow to establish a real relation between infection foci in the oral cavity and some of systemic illnesses. It should be remembered that prevention of the formation of the infection foci in the oral cavity is of importance. It can be done by the employment of proper hygienic procedures, regular control appointments, constant patients' informing about the role of stomatognathic system in maintaing the health of the whole organism.

REFERENCES

1. Bergstrom J. et a.l: Myocardial infarction end periodontal disease. J. Dent. Res., 779 Abstr., 2872, 1998.
2. Borczyk D., Malenta-Markiewicz E.: Leczenie endodontyczne pacjentów obciążonych chorobami ogólnymi. Stom. Współcz., 10, 1, 8, 2003.
3. Bubiłek-Bogacz A., Waskowska J.: Znaczenie wpływu ognisk zakażenia zębopochodnego u osób w starszym wieku, szczególnie z chorobami ogólnymi. Gerontol. Pol., 9, 1, 19, 2001.
4. Jeffcoat M.K. et al.: Current Evidence Regarding Periodontal Disease as a Risk Factor in Preterm Birth. Ann. Periodontol., 6, 183, 2001.
5. Konopka T.: Periodontal medicine. Nowy obszar badań we współczesnej periodontologii. Por. Stom., 3, 8, 38, 2003.
6. Langowska-Adamczyk H. et al.: Ropień przerzutowy pochodzenia zębowego w kanale kręgowym. Czas. Stomat., LIV, 11, 2001.
7. Larkin E.B., Scott S.D.: Przerzutowy ropień okołokręgowy i porażenie kończyn dolnych w następstwie ekstrakcji zębów. Przypomnienie poważnych następstw infekcji w jamie ustnej. Mag. Stomat., 5, 2, 33, 1995.
8. Mattila K.J. et al.: Association between dental health and acute myocardial infarction. Br. Med. J., 225, 779, 1989.
9. Mojon P.: Oral Health and respiratory infection. J. Can. Dent. Assoc., 68, 6, 340, 2002.
10. Murray C.A., Saunders W.P.: Root canal treatment and general health; a review of the literature. Int. Endod. J., 33, 1, 2000.
11. Nowak-Kwater B. et al.: Znaczenie kliniczne zębopochodnych ognisk zakażenia. Przew. Lekarza, 7/8, 108, 2003.
12. Offenbacher S. et al.: Periodontal infection as a possible risk factor for Preterm Low Birth Weight. J. Periodontol., 67, 1103, 1996.
13. Piątowska D.: Przeszłość i przyszłość teorii zakażenia ogniskowego. Stom. Współcz., 10, 2, 25, 2003.

14. Różyłło T. et al.: Częstość występowania jatrogennych ognisk zakażenia pochodzenia endodontycznego na podstawie zdjęć pantomograficznych. Por. Stom., 4, 17, 2002.
15. Szymaniak E.: Zębopochodne zakażenie ogniskowe. PZWL, Warszawa 1983.
16. Symcha Wajs: O zagadnieniu zakażenia ogniskowego w zarysie. Mag. Stomat., 4, 59, 1995.
17. Teichmann G. et al.: Czy zębopochodny ropień mózgu jest rzadko spotykanym powikłaniem? Mag. Stomat., 5, 6, 39, 1995.
18. Wasilewska A. et al.: Objawy zespołu Melkerssona-Rosenthala. Opis przypadku. Nowa Stomat., 7, 3, 151, 2002.
19. Żurek A.: Narząd żucia a kłębkowe zapalenie nerek. Stomat. Współcz., 8, 5, 22, 2001.

SUMMARY

On the basis of the contemporary literature the authors present views on the influence of the infection foci present in the oral cavity on both organism health state and the occurrence of various severe systemic diseases. The work includes patterns of behaviour in people endangered with focus induced disease. The problem of focal infection links dentistry with other medical specialties and it requires complex, interdisciplinary cooperation of doctors.

Ogólnoustrojowe oddziaływanie pierwotnych ognisk zakażenia zlokalizowanych w jamie ustnej

Na podstawie współczesnego piśmiennictwa autorki przedstawiają poglądy na temat wpływu ognisk zakażenia obecnych w jamie ustnej na stan zdrowia organizmu i występowanie szeregu groźnych chorób ogólnoustrojowych. W pracy uwzględniono schematy postępowania u osób zagrożonych chorobą odogniskową. Problem zakażenia ogniskowego łączy stomatologię z innymi specjalnościami medycznymi i wymaga kompleksowego, interdyscyplinarnego współdziałania lekarzy.