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Zagrożenia wirusowe w pracy lekarza dentysty

Viral threat in the dentist's work

Streszczenie

Lekarze dentyści są grupą zawodową niezwykle narażoną na zakażenie wirusowe. Wynika to ze specyfiki ich pracy; stomatolodzy operują ostrymi, rotacyjnymi narzędziami, pracują w bezpośrednim kontakcie i torze oddechowym pacjenta, przy wielu zabiegach wytwarzany jest spray wodno-powietrzny. Drobnoustroje chorobotwórcze mogą być przenoszone w stomatologii wieloma drogami. Analizując zagrożenia wirusologiczne personelu stomatologicznego nie sposób pominąć aspektu zakażeń zakładowych. Gabinet stomatologiczny może być potencjalnym miejscem przeniesienia zakażenia wirusowego z pacjenta na personel, z personelu na pacjenta i pomiędzy pacjentami.

Problem ten jest niezwykle aktualny, a liczba procesów z tytułu zakażenia i zasądzanych kwot odszkodowań stale wzrasta. Odsetek roszczeń w stosunku do gabinetów stomatologicznych wynosi 6.3% ogółu roszczeń.

Z powyższych przesłanek wynika konieczność ustawicznego kształcenia personelu stomatologicznego w zakresie zapobiegania przenoszeniu zakażeń wirusowych i uświadamianie wagi tego problemu. Istnieje szerokie spektrum wirusów, które mogą stanowić zagrożenie dla personelu stomatologicznego. Część z nich jest często opisywana i z pewnością dobrze znana, w niniejszym artykule zostaną scharakteryzowane wybrane z nich; te, które mają znaczenie ze względu na liczbę zachorowań i ciężkość konsekwencji oraz te, które być może rzadziej w świadomości lekarzy są wiązane z procedurami stomatologicznymi. W artykule przeanalizowano rolę wirusów zapalenia wątroby B i C, wybranych herpesvirusów, wirusa grypy, HPV, TTV oraz wirusa BK.

Słowa kluczowe: wirusy, stomatologia, zakażenia wirusowe.

Abstract

Dentists are a professional group that is extremely exposed to viral infections. It results from the specificity of their work; dentists operate with sharp and rotary tools, work in respiratory paths in direct contact with patients and water-air spray is created during many operations. In dentistry, pathologic microorganisms can be spread in a number of ways. While analyzing viral threat to dental crew, hospital infections must be taken into consideration. Dental operating rooms may be a potential place where viral infection can spread from patients to personnel, from personnel to patients or between patients.

The issue in question is extremely up-to-date and the number of lawsuits on account of infections and amounts of damages is on the rise. The proportion of claims about dental operating rooms makes 6.3% of the total of claims in Poland.

Basing on the above assumptions, the constant education of dental staff about the prevention of viral infections and the rise of the awareness about of the issue are needed. There arenumerous viruses that can pose a threat to dental staff. Some of them are frequently described and certainly well-known; in this article, some of them will be described; those which are relevant to the number of illnesses and the weight of consequences, and those which are perhaps less often, in dentists mind-sets, connected to dental procedures. In this article we analyzed the role of hepatitis B and C viruses, some of herpesviruses, influenza virus, HPV, TTV and BK virus.

Keywords: viruses, dentistry, viral infection.

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Dentists are a professional group that is extremely exposed to viral infections. It results from the specificity of their work; dentists operate with sharp and rotary tools, work in respiratory paths in direct contact with patients and water-air spray is created during many operations. In dentistry, pathologic microorganisms can be spread in a number of ways; blood-borne route, saliva-droplet route, direct contact with a patient and contaminated equipment (transfer from skin to mucous membrane or from skin to skin), water-droplet-route (aerosol aspiration, including retroaspiration, absorption, implantation, foreign body ingestion, exposure to conjunctival sac) [1]. While analyzing viral threat to dental crew, hospital infections must be taken into consideration. Dental operating rooms may be a potential place where viral infection can spread from patients to personnel, from personnel to patients or between patients. The issue in question is extremely up-to-date and the number of lawsuits on account of infections and amounts of damages is on the rise. The proportion of claims about dental operating rooms makes 6.3% of the total of claims in Poland [2]. Basing on the above assumptions, the constant education of dental staff about the prevention of viral infections and the rise of the awareness about of the issue are needed [3]. There are numerous viruses that can pose a threat to dental staff. There are: herpesviruses, mainly HSV-1 (*herpes simplex virus* type 1), HHV3 (*varicella zoster virus*), HHV4 (EBV - limphotropic Epstein-Barr virus), HHV 5 (CMV cytomegalovirus), viruses from *Orthomyxovindae* family (influenza virus), *Paramyxoviridae* (paramyxovirus, epidemic parotitis (mumps), morbilli (measles), respiratory syncytial virus (RSV), *Picornaviridae* (Coxsackie viruses causing herpangina), rhinoviruses, *Retroviridae* (HIV), hepatitis viruses (B, C, D, E) [1,4]. Some of them are frequently described and certainly well-known; in this article, some of them will be described; those which are relevant to the number of illnesses and the weight of consequences, and those which are perhaps less often, in dentists mind-sets, connected to dental procedures.

The hepatitis C virus is a member of the *Flaviviridae* family of viruses which are associated with human and animal diseases [5]. Hepatitis C is a RNA virus and has a high mutation rate. Frequent mutations result in the problem with vaccine construction. HCV is an enveloped virus that encloses its long, single-stranded, positive sense genomic RNA within an icosahedral capsid. HCV infection is still the most common chronic blood-borne infection [6,7]. In Poland about 50-60% of illnesses are related to medical operations [8]. Approximately 130-170 million world's population is infected by hepatitis C virus [9]. The World Health Organization (WHO) estimates that 3% (about 180 million) of the world's population is infected by HCV, with prevalence ranging from 0.1-5% in different European countries. It is estimated that 170 million people throughout the world are infected with HCV; about 5 million in Western Europe and 4 million in the U.S. [10,11]. Region-specific estimates range from <1.0% in Northern Europe to >2.9% in Northern Africa. The lowest prevalence (0.01%-0.1%) has been reported in the United Kingdom and Scandinavia; the highest prevalence (15-20%) has been reported in Egypt. From about 3 to 4 million people are infected every year [12]. In Poland there are about 500.000-700.000 infected with viral hepatitis which constitutes about 1.7% of the country's population [8]. HCV-induced liver diseases (mainly hepatitis) are the most common indication for liver transplantation in developed countries. Viral hepatitis C is in most cases asymptomatic and is often detected by incident, when the patient's body has been already irreversibly changed. Thus, viral hepatitis C is sometimes described as a 'viral time bomb'. Also for this reason, it poses an extreme threat to medical staff and other people who can be in contact with the blood of infected person (beauty salons, tattoo parlors, etc). Thus, we should always remember about the basic rule of infection control which states that every patient should be treated as a potential source of infection. We should bear in mind that HCV is an oncogenic, primary hepatotropic virus, but its oncogenity in relation to other organs cannot be excluded [13]. A person can be infected by a contact with infected blood (cuts, contact with infected tools, during injection drug use), nosocomial and perinatal exposure: those ways of spreading the disease raise no doubts and are commonly known. Several studies have reported low levels of suspected sexual and household transmission. It needs to be stressed that saliva is only seemingly a safe material; in 50% of patients infected with chronic hepatitis C, HCV RNA was detected in saliva [14]. In addition, saliva contamination with blood cannot be excluded, e.g.: in patients with gums diseases or while carious deflect sub-gingival processing. It is estimated that the risk of infection following needle stick injury from a seropositive patient is about 1.8% [15]. The risk of saliva exposure to the conjunctival sac or to the skin, even while performing non-invasive dental operations, needs to be avoided; dentists should also remember about the risk of being bitten by a patient. The possibility of being infected in a dental operating room results not only from an accidental prick or cut with an infected tool. The infection can also be spread with dental unit water lines (DUWL - is a narrow bore plastic tubing that carries water to the high speed handpiece, air/water syringe, ultrasonic scaler) [16], if a patient with hepatitis C was treated with the tool. In this report HCV-RNA (before treatment) was detected in serum of all patients and in saliva in a part of the group, but after dental treatment HCV-RNA was detected in the oral cavity fluid of all patients. After treatment, HCV-RNA was detected in sprays from a dental unit indicating that both the handpieces and fixed water were contaminated [12]. HCV RNA was detected in nasal secretions too [17]. Bearing in mind the fact that dentists work in patients' respiratory paths, all this information sheds light on the ways of infection spreading in a dental operating room. Considering the risk of HCV infection, it is worth to mention so called extrahepatic symptoms (manifestations) of hepatitis C infection, which could be noticeable for a dentist; it is estimated that about 15-50% of patients have xerostomia syndrome and alterations in salivary glands, frequently with lymphocytic inflammation that clinically can give sings of Sjörgen syndromes [18,19]. Lichen planus (Wilson's lichen) is the other pathology described as extrahepatic sign of hepatitis C. Patients with lichen have a higher titre of anti-HCV antibody in serum; it is possible that the infection with HCV of mucous membrane cells worsen the course of lichen. Thus the opinions about the

necessity of routine diagnostics (in terms of HCV infection and the necessity of distinguishing an illness subunit 'primary Sjörgen's syndrome dependent on HCV' [20-22]) of patients with flat lichen (especially when the lesions are multiple and located on gums) and Sjörgen's syndrome.

Hepatitis B virus (HBV) is a DNA virus, which belongs to *Hepadnae* family. Hepatitis B is an etiological agent of acute and chronic liver disease distributed throughout the world [23,24]. Probably, one third of the world's population has serological evidence of previous HBV infection. It is estimated that about 3% of chronically infected patients live in Europe [25] and these patients with active liver diseases are at serious risk of developing cirrhosis and hepatocellular carcinoma. However, nearly half of all primary infection in chronic carriers occurs in the perinatal period through maternal transmission, the other half arising from horizontal transmission mainly through intrafamilial spread or injection using unsterilized needles. It may be transmitted by blood, sexual contacts or vertical route. HBV DNA is detected in serum, nasopharyngeal fluid, urine, tears and saliva [26]. The most important for dentist staff is the fact that HBV DNA is detected in saliva, which suggests that saliva may be a vehicle for transmission [23]. Therefore dentists may become infected with HBV by an accidental needle-puncture, drill, reciprocating handpiece etc, accidental percutaneous injuries with infected instruments, and aerosols of blood, saliva or gingival secretion. We cannot exclude the risk of infection after exposure to eyes. Dentists should be concerned about the risk of being infected by a human bite [27]. It is estimated that the risk of infection following needle stick injury from a seropositive patient is about 2-30% and the minimum volume of blood to transmit infection is 0.00004 ml [15]. The introduction of obligatory vaccinations against hepatitis B caused a significant decrease of the infected in comparison with the period preceding the introduction of the vaccinations.

Herpesviruses have double-stranded DNA genome. This family consists of, among others, herpes simplex type 1 and 2 viruses, Epstein-Barr virus and cytomegalovirus. They have caused many problems in oral cavity. HSV type 1 is responsible for primary and recurrent infection of oral mucosa. Symptoms are ulcers that occur on the lips (herpes labialis) as a herpetic ulceration known as cold sores (especially during cold or another immunosuppression, after exposition to the sun, during menstruation) or on the mucosa (herpetic gingivostomatitis). HSV is detected in aggressive periodontitis with co-infected with CMV and EBV. Oral surgery and stress as well as anxiety related with dental treatment may influence an increase of HSV-1 level in saliva and may be a risk factor for asymptomatic shedding of the virus in seropositive patients. It is a potential risk of cross-infection within realms of dentistry [28,29]. EBV was the first human virus assigned with oncogenic potential. EBV is correlated with nasopharyngeal carcinoma, squamous cell carcinoma, Hodgkin's lymphoma, Burkitt's lymphoma [30,31]. EBV is an etiological agent of infectious mononucleosis also known as 'the kissing disease', because the virus spreads through direct mouth-to-mouth contact with saliva being the main vehicle for EBV transmission from human to human. Current data suggest that EBV is correlated with gingivitis, periodontitis, pulpitis, periapical inflammations and periodontal abscesses. Patients with these diseases report to dentists and that is why transmission from patients to dental staff is high [30-32].

CMV appears in human environment commonly and is rated as an opportunistic pathogen. Urine, blood, semen, uterine cervix secretion, stool, human milk and saliva can be infectious material. CMV infection is regarded as one of the most frequent causes of congenital viral infections and can lead to congenital symptomatic cytomegalovirus infections (growth retardation, jaundice, hearing defects), retinitis, encephalitis, mononucleosis like syndrome, organ transplant rejection [30,33]. Because of the negative impact on fetus development, CMV infection is particularly dangerous to pregnant dental staff. CMV infection has usually asymptomatic course, but is also related with periodontal diseases [32,34,35]. CMV and EBV are correlated and detected in Papillon-Lefevre syndrome periodontitis, Fanconi's anemia periodontitis, periodontal abscess [30].

Influenza viruses are single-stranded RNA viruses. They belong to the *Orthomyxoviridae* family. Three types of influenza viruses were found: A, B, and C. Type A virus occurs in different subtypes depending of the hemagglutinin (HA) and neuraminidase (NA) [36]. Influenza is an infectious disease that occurs all around the world. Every year 330-990 million people suffer from influenza worldwide. In Poland, there number of infected every epidemic season varies from a few hundred to few million [37]. In 2008 in Poland, 227 364 cases were registered [38]. "Swine flu" is a common name of the new strain of influenza virus A/H1N1, which began to spread in several countries around the world in April 2009 [39] and caused the first influenza pandemic of the 21st century [40]. Avian influenza virus ("bird flu") is a subtype A/H5N1 which has been circulating in Asia, Europe and Africa since 2003 [41]. The first human infections occurred in 1997 in Hong-Kong, and 27 March 2007 WHO confirmed over 370 cases of the infection among humans [42].

The infection spreads by saliva-droplet route and sometimes through direct contact with an infected person or contaminated surfaces (e.g. in dental practice) [37]. Dentists have contact with aerosols from patients' oral and nasal cavities. According to CDC instructions, patients with acute respiratory illness should be identified at check-ins and be placed in a single room with door closed. Patients suffering from influenza viruses infection, should wear surgical masks when outside the patient room and dental healthcare personnel assessing patients with influenza-like illnesses should wear disposable surgical facemasks, gloves, gowns and eye protection to prevent direct skin and conjunctival exposure. Despite of wearing masks, the risk of infection is still high. The influenza viruses can probably pass thorough protective barriers (e.g. masks) so a good preventive method would be to screen patients and postpone unnecessary dental practice in highly suspected cases [43].

Human papillomavirus (HPV) belongs to *Papillomaviridae* family. HPV is a double-stranded, non-enveloped DNA virus. Papilloma virus has epitheliotropism; cells' reproductive skin layers and mucosa are the target. High-risk oncogenic types 16 and 18 induce precancerous alterations and thus increase the risk of squamous cell carcinoma

development [44] and HPV in oral cavity and/or oropharynx is associated with increased risk of head, neck, cervical and other genitals cancer [45]. HPV can be transmitted by both sexual and non-sexual route [46]. Although HPV is transmitted by sexual ways, penetrative sex is not necessary for transmission; skin-to-skin genital contact is a well recognized mode of transmission. HPV can be transmitted from mother to child during birth and in consequence, infection may occur in the oral cavity [47] HPV DNA is detected in the buccal swabs [46] and in saliva [48], so saliva is a reservoir for HPV and a risk of transmission to dental staff during dental procedures is not excluded.

TT virus (Transfusion Transmitted Virus, Torque teno virus) belongs to *Anelloviridae* family; it is non-enveloped, single-stranded DNA virus. TTV infections have not yet been associated with specific diseases, but the infection with TTV has been suggested to be associated with liver diseases, respiratory and hematological disorders, periodontitis and cancers [49]. It is found in the serum of 1-92% of healthy people (depending on geographical region and age) and in 40% patients with non-A-non-G hepatitis. TTV DNA is detected in saliva, tears, semen and breast-milk of healthy people. The presence of TTV DNA in saliva might resulted from capillary diffusion of TTV from serum to saliva, the infection with subgroup of TTV that has tropism to saliva, and/or replication of TTV in salivary glands [50,51]. TTV DNA was detected in saliva of 59% of patients with periodontal disease [52].

BK virus (BKV) belongs to *Polyomavirus* family. It is double-stranded DNA virus and has been identified as the main cause of poliomavirus-associated nephropathy. The urogenital tract is the main site of infection without specific symptoms. However, during immunosupression destruction of kidney cells may occur. BKV DNA was detected in oral fluids and BK infection and replication occur in vitro in salivary gland cells. These data collectively suggest the potential for BKV oral route of transmission and oral pathogenesis [53,54].

Taking into consideration the multitude of viruses to which dentists are exposed to and possible consequences that result from infections, the necessity to practice basic rules of infections (which means treating every patient as a potential source of infection) needs to be highlighted. That's why dentists should work with adequate protective tools (protective coat, masks, goggles, gloves, face cover with so called 'safety glasses'), should observe disinfection and sterilization procedures along with carrying out necessary documentation. It is extremely important to proceed with caution with infective and biological material after operations; patients need to be instructed what to do with gauze pad after the extraction of a tooth [55]. Using prophylactic vaccination is a part of infection prophylactics. It is extremely important to prepare an algorithm of conduct in case of creating a situation that can lead to an infection [56] and constant training of dental staff [57].

The Polish parliament act from 5.12.2008 about prophylactics and elimination of infections and human infectious diseases describes the obligations of hospital facilities' directors and people who provide health welfare. Those people are obliged to carry out actions that prevent the spreading of infections and infectious diseases. Those actions are: the assessment of the risk of infection; the monitoring of alarm factors and infections; preparation, implementation and control over procedures that prevent infections and infectious diseases (including decontamination of the skin and mucous membrane or other tissues, medical products and the surface of rooms and tools); using of individual and mass protection products in order to prevent spreading of pathogenic biological factors to other people; providing health welfare.

Moreover, those people carry out the documentation of actions in question.

Nowadays, Polish researches show that dental operating rooms are equipped with autoclaves; however a significant number of dentists do not know available kinds of cycles. The process of disinfection can raise some reservations. In 30% of cases, solutions for tool disinfection are used repeatedly or tools are added to the previous part. After disinfection, dustbins are washed and disinfected in only 49% of the studied dental operating rooms. The authors describe irregularities in surface disinfection. Washing and disinfection after the patient reception are carried out only in 55% of cases. The authors also highlight irregularities in the documentation of sterilization process. Nearly 50% of respondents do not provide documentation for sterilization, only 10% presented the complete protocol which includes methods of sterilization, process' parameters, dates, the number of digester and the number of a cycle, the type of a load, the results of chemical and biological control, the signature of a person responsible for carrying out a sterilization. Another problem is that in only 18% of dental operating rooms, protocols are kept for at least ten years [2].

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