
Review

Risk of Cross-infection of Drug-resistant Bacteria in Dental Practice

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Abstract : Infection prevention and control in dental practice has been mainly focused on blood infections caused by Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency virus (HIV). Demand of dental practice for visiting hospital and nursing home has been rapidly increasing and that trend is expected to continue in the future. Therefore, management of infection control in dental practice is required to sufficiently understand not only HBV, HCV, and HIV but also various drug-resistant bacteria. Multidrug-resistant bacteria are considered to be serious threat worldwide. Here, we will review particularly major drug-resistant bacteria; methicillin-resistant *Staphylococcus aureus* (MRSA), multiple drug-resistant *Pseudomonas aeruginosa* (MDRP), extended-spectrum β -lactamase (ESBL), carbapenem resistant Enterobacteriaceae (CRE).

1. Introduction

Infection prevention and control in dental practice has been mainly focused on blood infections caused by Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency virus (HIV). Although its importance has been fully appreciated in recent years, there are still many problems to be solved because of the cost problem.

The number of patients who are difficult to visit dental clinics is increasing with the advent of a super-aging society in Japan. Aspiration pneumonia is particularly prevalent and one of the most serious problems in the elderly. It has been reported that professional oral health care for elderly patients in nursing home by dental hygienist prevents bacterial pneumoniae¹⁾. The system of peri-operative oral functional management has been popularized, since it has been covered by national health insurance. Therefore, demand for visiting hospital and nursing home is rapidly rising and that trend is expected to continue in the future. It is well known that long-term hospitalization and nursing home admission are risk factors to become a carrier of drug-resistant bacteria.

As a result, management of infection control in dental practice is required to sufficiently understand various drug-resistant bacteria, and all healthcare professionals have to take responsibility for minimizing the possibility of hospital infections.

2. MRSA (methicillin-resistant *Staphylococcus aureus*)

Staphylococcus aureus, which is a resident bacterium in the nasal cavity, oral cavity and intestine, produces various toxins including hemolysin and often causes purulent diseases. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major bacteria which causes hospital-acquired (HA) and community-acquired (CA) infections. MRSA is obtained by acquiring the staphylococcal cassette chromosome *mec* (SCC*mec*). *mecA* gene encodes a cell wall synthetase; Penicillin-binding protein 2' (PBP 2'), and it gains resistance to β -lactam antibiotics²⁾. Subsequently, multidrug-resistant MRSA having multiple resistance genes on the chromosome, such as quinolone resistance genes, aminoglycoside resistance genes, macrolide resistance genes, has been increasing.

MRSA is considered to be spread by hand to hand transfer in hospital. When we performed the environmental sampling for isolating MRSA at hospital rooms where MRSA patients were hospitalized, MRSA were isolated from the area frequently touched by the patient such as curtain, nurse call button, table and wash-basin. From this result, it was again confirmed that effective contact precautions is important.

3. MDRP (multi-drug resistant *Pseudomonas aeruginosa*)

Pseudomonas aeruginosa is an opportunistic pathogen which causes infectious diseases and grows in the human body, soil, and other natural environment. In spite of low pathogenicity, *P. aeruginosa* is a cause of chronic infections at all sites of the body and nosocomial infections because of an extracellular producer of biofilms.

Multiple drug-resistant *Pseudomonas aeruginosa* (MDRP) is defined as strains of *P. aeruginosa* resistant to three different types of antibiotics; imipenem, ciprofloxacin and amikacin. Treatment of MDRP infection is difficult, because there is only one effective drug; colistin (polymyxin E).

There are many types of drug-resistant mechanisms in MDRP. Some of the known mechanisms of antibiotic resistance are linked to: (a) the impermeability across membranes (eg, outer membrane porin OprD), (b) the efflux of the drug from the cytoplasm (eg, resistance-nodulation-division MexAB-OprM), (c) drug inactivation and modification by enzymes (eg, β -lactamases, aminoglycoside-modifying enzymes), and (d) changes in the targets of antibiotics (eg, mutation in the DNA gyrase, *gyrA* and topoisomerase IV, *parC*)³⁾.

4. ESBL (extended-spectrum β -lactamase)

Extended-spectrum β -lactamase (ESBL) are enzymes, which can degrade the 1st, 2nd and 3rd generation cephalosporins, but can not degrade the carbapenems. Cephalosporin is one of the β -lactam drugs and by far the most used antibiotics in the world. ESBL are produced by Enterobacteriaceae and the number of carriers has been rapidly increasing⁴⁾. ESBL-producing Enterobacteriaceae are emerging world wide. The ESBL-producing gene is encoded by a transmissible plasmid and is widely distributed in Enterobacteriaceae, non-fermentative glucose fermenting bacteria; *Escherichia coli*, *Klebsiella pneumoniae*, *Klebsiella oxytoca* and *Proteus mirabilis*. Risk factors for colonization with ESBL have been identified such as length of hospital stay, advanced age, urinary and intravascular catheters, and so on⁵⁾. ESBL-producing bacteria have an increasing number of carriers in the world. In the onset cases, carbapenems are effective.

5. CRE (carbapenem resistant Enterobacteriaceae)

Carbapenem is one of the β -lactam drugs and most effective against Gram-positive and Gram-negative bacteria with a broad spectrum. The emergence of carbapenem resistant Enterobacteriaceae (CRE) poses a serious threat in the world. CRE mainly produces β -lactamase called carbapenemase and is resistant to almost β -lactam drugs. The most effective carbapenemases are KPC, VIM, IMP, NDM and OXA-48 types⁶⁾. Infectious diseases caused by CRE are mainly *E. coli* and *K. pneumoniae*, and many are centered on urinary tract and respiratory organs, which may be refractory because it shows resistance to antibiotics. In Japan, it is expected that the number of reported cases is still not so much, however, it will gradually increase in Japan, considering the global situation.

6. Conclusion

These drug-resistant bacteria in this review are clinically isolated from sputum, urine, stool, pus, and other specimens. There is a strong possibility that they would colonize in the oral cavity. The basic principle of infection control is to prevent direct or indirect contact transmission and to sterilize or disinfect all instruments completely. It is important to acquire correct knowledge on drug-resistant bacteria and continue to take even more appropriate infection control procedure.

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