HKUMed Invents a Novel Two-dimensional (2D) Ultrasound-Responsive Antibacterial Nano-sheets to Effectively Address Bone Tissue Infection

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Researchers have invented a non-invasive and non-antibiotics technology to effectively reduce methicillin-resistant Staphylococcus aureus (MRSA) infection in bony tissue.

A research team led by Professor Kelvin Yeung Wai-kwok from the Department of Orthopaedics and Traumatology, School of Clinical Medicine, LKS Faculty of Medicine, the University of Hong Kong (HKUMed) has invented a non-invasive and non-antibiotics technology to effectively reduce methicillin-resistant Staphylococcus aureus (MRSA) infection in bony tissue.

The novel antibacterial nano-sheets can release a substantial amount of reactive oxygen species (ROS) subject to ultrasound stimulation. With the engulfment of neutrophil membrane (NM), the nano-sheets are able to actively capture the MRSA bacteria deeply seated in bony tissue and effectively eliminate 99.72% ± 0.03%. The outcome has been published in Advanced Materials.

Background

Bone infection, namely osteomyelitis, is an infection happened in bone or bone marrow caused by bacteria, fungi, or other microorganisms. The common causative pathogenic organism is MRSA. Severe infections can put patients at the risk of amputation or even induce life-threatening sepsis.

In clinical practice, the treatment of bone tissue infection typically involves antibiotics and surgical debridement to remove the infected bone or tissue. However, excessive use of antibiotics not only compromises the host’s innate immune function, but may also inevitably

induce the emergence of drug-resistant pathogens.

Recently, phototherapy, whatever it is photodynamic or photothermal therapy, has been applied as an antibiotic-free strategy to tackle bacterial infections. However, conventional phototherapy is unable to address the deep tissue infection such as bone due to its limited penetration power. Therefore, an alternative antibiotic-free strategy harnessing the penetration power of ultrasound to human tissues is considered.

Research findings and significance

Professor Kelvin Yeung Wai-kwok, remarked, ‘Our design has achieved a qualitative leap in which the ROS catalytic site in sonosensitiser has transformed from zero-dimensional to two-dimensional. This invention can remarkably increase the production of bactericide (ROS). We may also consider applying this invention to the post-operation bacterial infection commonly seen in bone cancer patients or the patients with cystitis and peritonitis in the future.’

Read the original article on University of Hong Kong.