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Electron Microscopy Research in Musculoskeletal Infection

Bingyun Li

West Virginia University School of Medicine, Morgantown, West Virginia, United States

Infections like COVID-19 have changed our lives and have reminded us of the challenges in dealing with all kinds of infections. The invention and use of antibiotics are given credit for the significant reduction of infections and saving millions of lives. However, the wide use of antibiotics has also created the latest grave challenge in patient care, i.e., antibiotic resistant bacteria, which have been increasing in recent decades. The Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) have identified antibiotic resistance as a great threat to health in 2013 and 2014, respectively. It is estimated that between 38.7-50.9% of microorganisms causing surgical site infections are resistant to standard prophylactic antibiotics.[1] In the U.S. alone, antibiotic resistant infections increased by 359% between 1997 and 2006,[2] and antibiotic resistant bacteria cause at least 2.8 million infections, 35,000 deaths a year,[3] and $55-70 billion per year in economic impact.[4] Besides antibiotic resistance, musculoskeletal infection treatment faces other challenges including biofilm formation, intra-cellular infection, delayed wound healing, etc.

In this paper, the successful use of electron microscopy to manage the challenges we are facing with musculoskeletal infections will be presented. Scanning electron microscopy and transmission electron microscopy have been applied from the observation of biofilm formation both *in vitro* and *in vivo*, to visualization of biofilm disruption, to exploration of antimicrobial mechanisms, and to further guiding the development of innovative antimicrobial biomaterials and therapeutic treatments. For instance, in the development of advanced antimicrobial biomaterials, electron microscopy has been used to characterize nanoparticles and surface structures, coating stability, and drug delivery vehicle structures, and to determine nanoparticle and bacteria internalization, as well as cell and bacteria attachment and morphology.

References

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