New Concepts and Goals of HyMedPoly - Drug free Antibacterial Strategies

Xiang Zhang
Principle Consultant at Lucideon, email: xiang.zhang@lucideon.com
Royal Society Industry Fellow at University of Cambridge; ;email: xcz20@cam.ac.uk

INTRODUCTION

The continuous advances in the treatment of disease/infection-related healthcare will lead to a strong demand for new therapeutic products. Medical device related infections account for substantial morbidity and cause a sharp increase in healthcare costs through prolonged hospitalisation and after-care. Particularly, implanted synthetic medical devices demonstrate a significant number of infections. The safety and efficiency of the medical devices need to be improved to drastically decrease infection rate from synthetic implants and medical devices that contact human tissue and/or body fluids. In Europe, at least 1.5% of the approximately 800,000 annually implanted orthopaedic devices are subjected to peri-prosthetic infections . In the United States alone at least 80,000 catheter related bloodstream infections occur annually in Intensive Care Units, leading to 24,000 patient deaths and increased healthcare costs ranging from approximately €7,000 to €45,000 per case. , . In this scenario, antibiotic resistance due to a lack of effective drugs to combat bacteria is one of the most serious health threats worldwide. Each year in the United States, at least 2 million people acquire serious infections from bacteria that are resistant to the antibiotics designed to treat them and at least 23,000 die as a direct result. The level of incidences is rising as some pathogens become resistant to multiple types or classes of antibiotics. The loss of effective antibiotics will undermine the ability to fight infectious diseases and manage the infectious complications. This presentation aims to introduce new concept and report outcomes of drug-free antibacterial therapeutic strategies vis a range of technologies that work in the best way that can potentially and efectively win the war on bacterias in most of applications.

METHODS

3 strategies - organic, inorganic and natural therapies, aiming to create antibacterial biomaterials with surface environments that make it difficult for bacteria to grow, including: (1) Honey Mimetic Polyurethane Based Wound Healing Scaffolds; (2) Therapeutic Polyurethane (PU): Amphipathic Antibacterial PU based Colloids; (3) Bioresorbable polyesters & Copper (II)-Chitosan Hybrids; (4) Functioned Biodegradable and Bioresorbable Polyesters; (5) Novel Natural Polymers with Antibacterial properties; (6) Hybrid polymers based antibacterial hydrogels for wound healing applications; (7) Bioactive Silica Glass with antibacterial functionality; (8) A Study of Substituted Hydroxyapatites for Antibacterial Applications; (9) Bioresorbable Phosphate Based glasses for antibacterial applications; (10) Development of natural polymers for Antibacterial Nerve Conduits; (11) Natural hybrid polymers equipped with antibacterial functionalities; (12) - New Antibacterial Study of Mechanobiology of Cell-Surface Interaction; (13) Mechanics of Porous and Structured Antibacterial Biomaterials; (14) Bio-analysis of Antibacterial Biomaterials - Prevention Microbial Wound Infections; (15) Study on Antibacterial Efficacy and Safety of Novel Amphipathic Polyurethanes

RESULTS AND DISCUSSION

The challenge is to develop new medical materials that have an intrinsic antibacterial functionality to achieve clinical effectiveness; to develop a new generation of industrial professionals is needed who will firstly understand new concept of innovation from concept to commercialisation, and can implement new strategies to combat bacteria; and the best way to achieve the goals of science and technology in HyMedPoly project: ORANIC - through synthetic pathway: develop new hybrid polymers synthetic and natural “equipped” with antibacterial functionality, INORGANIC – through design new molecular structure of inorganic nature to make them naturally processing antibacterial functionality LEARN FROM NATURE – build new materials with natural inhibitors that can permanently deactivate bacteriological proteases and In combination of (a), and/or (b), and/or (c)

CONCLUSION

Drug-free antibacterial strategies and prodcuts can be designed and developed with success

REFERENCES

1.Science and Principles of Biodegradable and Bioresorbable Medical Polymers - Materials and Properties, 2016 by Elsevier; 2.Inorganic Controlled Release Technology, 1st Edition - Materials and Concepts for Advanced Drug Formulation, 2015 pub. by Elsevier; 3. Inorganic Biomaterials: Structure, Properties and Applications, 2014 pub. By Smithers Rapra

ACKNOWLEDGMENTS

Authors should acknowledge for HyMedPoly team of 15 students and their supervisors; special thanks to the project manager Stuart MacLachlan for his great contributions to the success. The author would like to thank H2020 Marie Skłodowska-Curie Actions (Grant no: Proposal No. 643050 - HyMedPoly) for providing financial support to this project.