Interactions of biological responses and localized corrosion on the surface of biomedical metals

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Abstract Metal implant materials are widely used in artificial bones and joints due to their high strength, good wear resistance, and good biocompatibility, However, high revision rates of metal orthopedic implants are still a clinical challenge. The revision rate for metal-on-metal hip prostheses at 10 years is over 15%, much higher than other implant materials. Corrosion, especially localized corrosion, is an important factor for the high revision rate of metal implants. Localized corrosion not only causes material performance degradation, the interaction and cross effect between metal corrosion and in vivo biological response may cause adverse local tissue reactions around the orthopedic implant and even systemic metalliosis. The clinical problems caused by corrosion have great attention by health departments from many countries, and regular blood metal ion testing for patients with metal-on-metal replacement was recommended. On account of the above corrosion-related issues, we systematically investigated the interaction between localized corrosion of metal implants and surface biological responses, disclosed the interaction pathways and cross-effect mechanisms of protein adsorption, mesenchymal stem cell adhesion and macrophage inflammatory response with localized corrosion from both molecular aspect (or mass aspect) and electrochemical aspect, revealed the underlying nature of long-term failure of metal implants, and provided scientific evidences for the risk evaluation and control of the orthopedic implant failure in clinical practice.

Keywords biomedical metals, Localized corrosion, Protein adsorption, Mesenchymal stem cells, Inflammatory reactions, Cell-material interaction, Electrochemistry

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