Cellular responses of smooth muscle cell to zinc ion

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Introduction: Magnesium, zinc and ferrous-based alloys represent the new generation of biodegradable biomaterials for cardiovascular stent applications. Up to date, magnesium alloys have been widely investigated and thought to be promising in implants applications. However, the rapid corrosion and unideal mechanical strength hindered their development. Although alloying other elements may enhance the mechanical strength and corrosion resistance, biocompatibility is another concern. Recently, some researchers have shown that zinc-based alloys may have more advantages over magnesium-based alloys for stent application. Compared to magnesium alloys, zinc alloys have lower corrosion rate and better biocompatibility. Also the effects of their corrosion products satisfy the requirements for stent application. Few studies have been reported about the *in vitro* biocompatibility of zinc-based alloys. In this study, we explored the effects of zinc ion on human primary smooth muscle cells.

Materials and Methods: The human aortic smooth muscle cells (HASMC) were culture in smooth muscle cell medium (SMCM). The zinc ion solutions were in the form of zinc chloride and were prepared by dissolving $ZnCl_2$ into deionized water and dilated into desired concentrations by SMCM. Cell adhesion test was used to detect the influence of zinc ion on smooth muscle cell adhesion. The adhesion strength between smooth muscle cells and the substrate was characterized by centrifuge assay. Cell viability was explored by MTT test and cell proliferation was detected by Brdu cell proliferation test. Cell migration was evaluated by wound healing assay. The responses of cytoskeleton and cell morphology to zinc ion were evaluated by immunofluorescence staining. And the effects of zinc ion on cell membrane integrity were explored by LDH test. The mechanism of some cellular responses to zinc ion were explored by gene expression.

Results: Low concentration zinc ion can enhance cell adhesion, cell viability, cell proliferation and cell migration. High concentration zinc ion inhibited these cellular responses. The cytotoxicity was dependent on the zinc ion concentrations. The intensity of immunofluorescence staining and gene expression profile responded to zinc ion in a concentration-dependent manner.

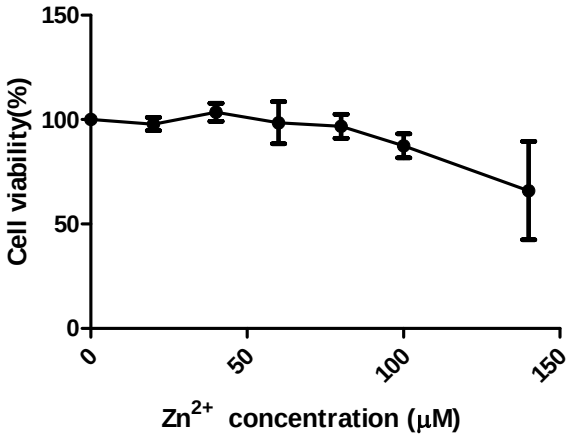

Fig 1. The viability of smooth muscle cells incubated with different zinc chloride solutions.

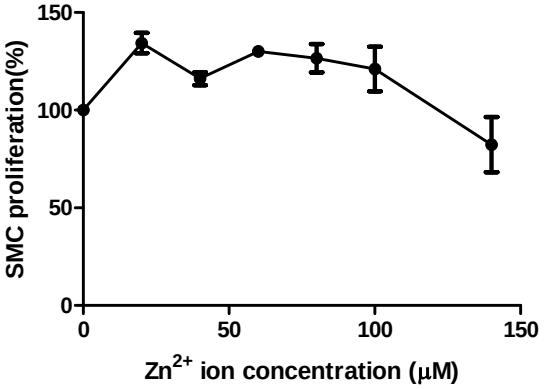

Fig 2. The proliferation of smooth muscle cells incubated with different zinc chloride solutions.

Conclusions: The cellular responses of smooth muscle cells to zinc ion are concentration-dependent. Low concentration zinc ion is beneficial to smooth muscle cells and high concentration zinc ion has opposite effects. Our future research will focus on cellular responses of endothelial cells to zinc ion. Understanding how zinc ion affects endothelial and smooth muscle cell will provide insights for designing zinc-based cardiovascular stent.