Cent. Eur. J. Biol.
DOI: 10.2478/s11535-013-0261-2

VERSITA

Central European Journal of **Biology**

Do novel cement-type biomaterials reveal ion reactivity that affects cell viability *in vitro*?

Research Article

Agata Przekora[1,*], Joanna Czechowska[2], Dawid Pijocha[2], Anna Ślósarczyk[2], Grażyna Ginalska[1]

[1]*Chair and Department of Biochemistry and Biotechnology, Medical University of Lublin, 20-093 Lublin, Poland*

[2]*Faculty of Materials Science and Ceramics, AGH-University of Science and Technology, 30-059 Krakow, Poland*

Received 25 March 2013; Accepted 02 September 2013

Abstract: Calcium phosphate bioceramics have been studied as bone filler materials for years and have become a component of many commercial products. It is widely known that surface-reactive biomaterials may cause changes in the concentration of crucial ions in the surrounding environment, thereby affecting cell metabolism and viability. The aim of this study was to produce five cement-type biomaterials and characterize their phase composition using X-ray diffraction method, and porosity and pore size distribution using mercury intrusion porosimeter. We then evaluated ion interactions of the novel biomaterials with the surrounding environment (culture medium). A commercially available bone substitute, HydroSet™ (Stryker®), was used as a reference. MTT and NRU cytotoxicity tests were performed to assess the effect of changes in the concentration of crucial ions (calcium, magnesium, phosphate) on osteoblast metabolism and viability *in vitro*. Our study clearly indicated that various biomaterials demonstrated different ion reactivity and consequently may cause changes in ion concentration in the local environment. Critically low or high values of calcium, magnesium, and phosphate concentrations in the medium exerted cytotoxic effects on the cultured cells. Moreover, we discovered that the chemical composition of the culture medium had a substantial influence on ion interactions with biomaterials.

Keywords: *Ionic interactions • Bone cements • Calcium phosphate bioceramics • Bone filler • Cytotoxicity • Cell culture*

1. Introduction

In the field of bone graft, bioceramic substitute materials combine biocompatibility (sometimes also bioactivity) and resorption, but their low strength limits their application to defects in non-load-bearing, mechanically stable bone. Calcium phosphates (CaPs) have been studied as bone repair materials for years and have become a component of many commercial products. Traditional high-temperature calcium phosphates such as hydroxyapatite (HA), β-tricalcium phosphate (β-TCP), and α-tricalcium phosphate (α-TCP), as well as low-temperature calcium phosphate bone cements (CPCs) with improved surgical handling properties belong to the group of bioactive ceramics, which bond directly to the bone [1]. In recent years, many investigations have concentrated on calcium phosphate cements. CPCs are obtained by mixing one or several active calcium phosphate powders with an aqueous solution to form a paste that hardens within a restricted period of time (*e.g.* 15 min). These materials may be classified into two categories: apatite cements, whereby the final product of the setting reaction is HA, and brushite cements, whereby brushite (dicalcium phosphate dihydrate, DCPD) is formed. *In vivo,* brushite is converted into hydroxyapatite. Two types of setting reactions may be distinguished for CPCs: acid-base reactions and/or fast hydrolysis of a metastable calcium phosphate phase into HA, which is associated with larger or smaller pH variations of the paste during setting. The main difference between the cements after the setting reaction lies in the Ca : P molar ratio, presence of impurities

* *E-mail: agata.przekora@umlub.pl*