In Vitro Cell.Dev.Biol.—Animal (2015) 51:230–240
DOI 10.1007/s11626-014-9828-0

Static magnetic field enhances synthesis and secretion of membrane-derived microvesicles (MVs) rich in VEGF and BMP-2 in equine adipose-derived stromal cells (EqASCs)—a new approach in veterinary regenerative medicine

Monika Marędziak · Krzysztof Marycz · Daniel Lewandowski · Anna Siudzińska · Agnieszka Śmieszek

Received: 12 July 2014 / Accepted: 23 September 2014 / Published online: 27 November 2014 / Editor: T. Okamoto

Abstract The aim of this work study was to evaluate the cytophysiological activity of equine adipose-derived stem cells (ASCs) cultured under conditions of static magnetic field. Investigated cells were exposed to a static magnetic field (MF) with the intensity of 0.5 T. In order to investigate the effects of magnetic field on stem cell signaling, the localization and density and content of microvesicles (MVs) as well as morphology, ultrastructure, and proliferation rate of equine ASCs were evaluated. Results showed that potential of equine adipose-derived mesenchymal stem cells was accelerated when magnetic field was applied. Resazurin-based assay indicated that the cells cultured in the magnetic field reached the population doubling time earlier and colony-forming potential of equine ASCs was higher when cells were cultured under magnetic field conditions. Morphological and ultrastructural examination of equine ASCs showed that the exposure to magnetic field did not cause any significant changes in cell morphology whereas the polarity of the cells was observed under the magnetic field conditions in ultrastructural examinations. Exposition to MF resulted in a considerable increase in the number of secreted MVs—we have clearly observed the differences between the numbers of MVs shed from the cells cultured under MF in comparison to the control culture and were rich in growth factors. Microvesicles derived from ASCs cultured in the MF condition might be utilized in the stem cell-based treatment of equine musculoskeletal disorders and tendon injuries.

Keywords Magnetic field · Adipose-derived mesenchymal stem cells · Microvesicles · Equine

M. Marędziak (✉) · K. Marycz · A. Siudzińska · A. Śmieszek
Electron Microscopy Laboratory, University of Environmental and Life Sciences Wroclaw, Kozuchowska 5b, 51-631 Wroclaw, Poland
e-mail: monika.maredziak@gmail.com

M. Marędziak
Department of Animal Physiology and Biostructure, Faculty of Veterinary Medicine, Wrocław University of Environmental and Life Sciences, Wroclaw, Poland

K. Marycz · A. Śmieszek
Wroclaw Research Centre EIT+, Stablowicka 147, 54-066 Wroclaw, Poland

D. Lewandowski
Institute of Materials Science and Applied Mechanics, Wroclaw University of Technology, Smoluchowskiego 25, 50-372 Wroclaw, Poland

Introduction

The essential components of the current veterinary regenerative medicine are the therapies involving application of multipotent stromal cells (MSCs). These cells have the capacity to self-renew and differentiate into the cells of various lineages, e.g., osteoblasts, chondrocytes, or adipocytes, but they can also express markers specific for endothelial cells and cardiomyocytes (Marion and Mao 2006; Gimble *et al.* 2007; Augello and De Bari 2010). They are characterized by multipotency, plasticity, and immunomodulatory properties, which make them a promising tool in the modern veterinary regenerative medicine (Mizuno *et al.* 2012; Zomorodian and Eslaminejad 2012). Bone marrow and adipose tissue provide the most accessible source of adult stem cells. Moreover, the role of adipose-derived stem cells (ASCs) is becoming increasingly important particularly in the veterinary clinical treatment of large animals (Guest *et al.* 2008; Marycz *et al.* 2012a; Barba *et al.* 2013). Recently, MSCs have been more readily applied in equine veterinary medicine. The results of many research groups as well as our previous studies have