Cent. Eur. J. Biol. • 8(3) • 2013 • 215-225
DOI: 10.2478/s11535-013-0137-x

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Central European Journal of **Biology**

Adult stem cells derived from skeletal muscle – biology and potential

Review Article

Ľuboš Danišovič*, Štefan Polák, Ján Vojtaššák

Institute of Medical Biology, Genetics and Clinical Genetics,
Faculty of Medicine, Comenius University,
811 08 Bratislava, Slovak Republic

Received 13 July 2012; Accepted 27 November 2012

Abstract: Skeletal muscle contains at least two distinct populations of adult stem cells – satellite cells and multipotent muscle–derived stem cells. Monopotential satellite cells are located under the basal lamina of muscle fibers. They are capable of giving rise only to cells of myogenic lineage, which play an important role in the processes of muscle regeneration. Multipotent muscle–derived stem cells are considered to be predecessors of the satellite cells. Under proper conditions, both *in vitro* and *in vivo*, they undergo myogenic, cardiogenic, chondrogenic, osteogenic and adipogenic differentiation. The main purpose of the present article is to summarize current information about adult stem cells derived from skeletal muscle, and to discuss their isolation and *in vitro* expansion techniques, biological properties, as well as their potential for regenerative medicine.

Keywords: *Satellite cells • Multipotent muscle derived stem cells • Differentiation • Tissue engineering • Regenerative medicine*

1. Introduction

Stem cells are generally characterized as clonogenic, undifferentiated cells which have been derived from embryonic, fetal, and adult organisms [1-3]. These cells are capable of long-term self-renewal and they are unique in their potential to generate various types of tissues under proper *in vitro* and *in vivo* conditions [4]. Embryonic stem cells derived from embryoblasts are pluripotent – they are able to differentiate into cell types of all three germ layers. Moreover, they possess unlimited capacity for symmetric divisions that provide their long-term self-renewal [5], though their utilization is restricted by ethical considerations in many countries [6]. For this reason, adult stem cells represent a promising and more acceptable tool for tissue engineering and regenerative medicine. They are characterized by multipotency (Figure 1), asymmetric division, and capacity for self–renewal [7]. Over the past few years, adult stem cells have been derived from various types of tissues, including bone marrow, umbilical cord blood, adipose tissue, skin, dental pulp, placenta, and other tissues [8-13]. Adult stem cells are adherent and have a fibroblast-like morphology as well as having the ability to produce colony-forming units-fibroblast (CFU-F) when cultured *in vitro* [8]. These cells are heterogeneous and express a variety of surface markers including CD29, CD44, CD56, CD73, CD90, CD105, CD106, CD133, CD166, CD271, STRO–1, and Sca–1. On other hand, they are negative for haematopoietic and blood lineage markers, including CD14, CD31, CD34, CD45, and c-Kit. Moreover, majority of them do not express HLA Class II markers [4,14-16].

The most important impact of that stem cells may have in the area of regenerative medicine is their "healing" potential. They promote processes of tissue repair and the regeneration of diseased and destroyed tissues. They act not only through the processes of active transport, differentiation and incorporation into damaged tissue, but also by promotion of angiogenesis and by their antiinflammatory and antifibrotic properties. Stem cells also produce variety of biologically active molecules (soluble factors), thereby influencing their local environment (activation of resident cells).

* *E-mail: lubos.danisovic@fmed.uniba.sk*