Invited editorial on “Myogenic satellite cells: Physiology to molecular biology”

ESPEN SPANGENBURG AND FRANK BOOTH
Department of Veterinary Biomedical Sciences, University of Missouri, Columbia, Missouri 65211

SKELETAL MUSCLE RESEARCH within the last 25 years has exploded with great interest and enthusiasm among many physiologists, molecular biologists, and biochemists. This has occurred because an enhanced physiological function of skeletal muscle improves the overall health status of an individual. In fact, we and others have argued that increasing muscle size and performance will reduce physical frailty and metabolic dysfunctions. Currently, many investigators are concentrating their research focus on mechanisms that regulate skeletal muscle growth and/or regeneration. These topics are of great scientific and clinical interest because it is believed that therapeutic manipulation of these mechanisms can improve the quality of life in individuals stricken with various conditions such as sarcopenia, congestive heart failure, or muscular dystrophy.

Although the existence of satellite cells has been known since 1961, the complex regulatory mechanisms of these cells are poorly understood. The up-to-date review by Hawke and Garry in this issue of the Journal of Applied Physiology provides an in-depth examination of the literature concerning the physiology and biochemical roles of satellite cells in skeletal muscle. Within the last decade, biological researchers have begun to make remarkable strides regarding the role of satellite cells in muscle growth and regeneration. Many of these investigations have made significant findings regarding the role of various growth factors (e.g., insulin-like-growth factor I) and the role of these factors in the stimulation of satellite cell proliferation and/or differentiation. With increased development of various biochemical and molecular techniques, it is not unreasonable to suggest that, with the advent of gene delivery to human skeletal muscle, doctors will be able to regulate the proliferation of satellite cells. Furthermore, it may soon be possible to isolate satellite cells, genetically manipulate them, and deliver them via the circulation back to the skeletal muscle that may be in need of repair. For example, it may be possible to enrich and manipulate satellite cells to express the dystrophin gene and return them to the muscle, thereby acting as a possible repair mechanism for Duchenne muscular dystrophy (1, 2). Unfortunately, this ex vivo gene therapy method has been largely unsuccessful in humans that exhibit muscular dystrophy (2). Currently, it is thought that, in order for this approach to be successful, scientists must increase the survival percentage of the injected myoblasts and further increase the expression of dystrophin in the myoblast-transduced myofibers (1, 2). Although it is clear that these results are providing new avenues for satellite cell research, it is apparent that more advances in the biological technology field are necessary to increase the possible uses of satellite cells by the scientific and medical community (1).

Hawke and Garry’s review therefore provides an important, thorough examination of the role of satellite cells in various disease states and possible intrinsic/extrinsic cues that may affect the function of these cells. For example, the review discusses literature concerning satellite cell senescence under various conditions (e.g., muscular dystrophy and aging) and how this reduction in proliferation may exacerbate the debilitating effects of these conditions. Furthermore, the review provides insight on a relatively recent discovery of a particular subpopulation of satellite cells, termed “side population cells,” which have the ability to act like stem cells and can be incorporated into other nonmuscle tissue. This suggests the potential that this subpopulation of satellite cells can be used in the repair of other damaged nonmuscle tissue, a possibility that might lead to possible therapeutic treatments of nonmuscle-specific conditions. In addition, the authors insightfully suggest that, to completely elucidate the role of satellite cells in skeletal muscle growth and regeneration, investigators will have to integrate multiple biological disciplines.

In summary, this timely contribution will serve as an invaluable resource for scientists attempting to understand the biochemical and molecular events linked to satellite cell regulation. This article updates an established but quickly evolving field and will provide a starting place for a wide variety of scientists trying to determine the necessary tools and mechanisms to examine the role of satellite cells in skeletal muscle biology.

REFERENCES
