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Bridging Stem Cell Research from Humans to Animals

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Translational stem cell research is a relatively young subspecialty of clinical research in animals. Although the success of therapeutic stem cell therapies in humans was based on research in small animal models, namely mice, development of clinical applications for farm and companion animals has been very limited so far. Because basic mechanisms regulating the physiology and function of stem cells are likely to be highly conserved between humans and animals, current practices and techniques that have been developed for human subjects can now be translated to improve animal welfare.

Embryonic stem cells, induced pluripotent stem (iPS) cells, fetal and adult stem cells are all the focus of active research worldwide [1]. Each of these stem cell types have their own unique characteristics and can serve a vital role, not only for clinical applications but also for basic research to further our understanding of disease mechanisms and for high-throughput screening of new compounds for therapeutic drug development. Indeed, tissue-specific adult stem cells are already being used clinically in humans; hematopoietic stem cells for bone marrow transplants have been utilized since 1968 [2] and stem cells derived from the skin [3], cornea [4] and adipose tissues [5] have also been utilized successfully in human clinical applications.

Allografting has greatly improved the quality of life for millions of recipients, but the immunosuppressant medication required to go with it has many side effects, including a reduction in life expectancy. However, the utilization of autologous adult stem cells to reconstitute damaged organs/tissues has now become a reality and future stem cell therapies will likely include their use in both humans and animals, as they greatly reduce the risk of transplant rejection and overcome ethical concerns related to the use of embryonic and fetal stem cells.

Cell autonomous intrinsic cues in stem cells play a significant role in regulating and maintaining their capacity for self-renewal. However, an increasing body of evidence suggests that the external microenvironment of stem cells, commonly referred to as the stem cell niche, also affects normal stem cell activities [6]. Indeed, it has been recently shown that stem cells exhibit different cellular behavior in response to different combinations of microenvironment signaling proteins [7]. Thus, “conditional priming” of the transplant site for stem cell application can dramatically affect outcome. However, further investigation into this exciting field of research is still required to achieve the full potential of stem cell transplantation.

As conditions that require stem cell therapies are relatively rare, research collaborations and teamwork will be critical for advancing translational stem cell research. Thus, in addition to collaborating within our own subspecialty, we must reach out to colleagues in other

disciplines to bridge basic research with clinical studies. It is also important that veterinary scientists/physicians establish strong collaborations with medical doctors who have significant expertise in stem cell therapies. The skills to facilitate the application of basic science discoveries to clinical options as well as to translate clinical applications from one species to others will revolutionize veterinary medicine in the future.

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