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EDITORIAL

Stem cells and regenerative medicine: The time is right for translation



Stem cells and regenerative medicine have been prevailing topics of biomedical research for the last two decades and they continue to remain prevalent in many medical fields, including orthopaedics. Many aspects of stem cell research and regenerative medicine are the focus of investigation in the form of stem cell biology, tissue engineering and biophysical stimulations. Breakthroughs in stem cell identification, harvesting, and cell therapy trials bring us novel choices and ideas on how to better use this novel research in treating patients. Tissue engineering concepts have been widely accepted but there are limited practical opportunities or clinical application guidelines for their use. Many surgeons and physicians incorrectly conclude that tissue engineering involves cells, biomaterials, bioactive factors, or a combination of these factors. In reality, the human body can be likened to a naturally occurring bioreactor and contains all the necessary components for tissue engineering and regeneration. For example, biophysical stimulation leads to regeneration of numerous musculoskeletal tissues under simple mechanical (tensile force) stimulation in a controlled manner. The human body has regenerative potential at all developmental stages, but the regenerative potential in the elderly needs to be activated or promoted by physical, chemical or biological means.

In this special issue of "Stem Cells and Tissue Engineering Applications in Orthopaedic Translation", we have assembled experts in the field of orthopaedic medicine who specialise in stem cell and regenerative medicine to share their insights. This special issue contains 9 review articles

and 1 original research article covering a wide range topics including regulatory issues [1], biophysical stimulation [2,3], stem cell tenogenic differentiation and their clinical applications [4,5], cell therapy in intervertebral disc repair [6,7] and cartilage regeneration [8], and mesenchymal stem cell recruitment and homing in bone repair [9,10]. These are important topics of current research in stem cell biology and regenerative medicine in the orthopaedic field, providing a multi-faceted insight into numerous developments and challenges.

The future of regenerative medicine research will focus on developing intelligent biomaterials and therapeutic protocols that can modulate the tissue repair process or activate the endogenous precursor cells. Intelligent biomaterials will have all the essential requirements as a normal biomaterial (e.g. mimicking the composition and structure of natural tissue), but it will be able to self-assemble or remodel itself to enhance the native tissue and some biomaterials may be able to slowly release bioactive molecules to minimise the number of procedures a patient undergoes. In addition, we need to develop functional assessment standards to measure clinical outcomes as the gold standard for assessing novel biomaterials and cell therapy protocols. Essentially, regenerative medicine approaches need to be simple and effective, with discrete clinical improvements, to enable their wider application and promotion.

There are numerous promising aspects of stem cell and regenerative medicine for clinical applications; however, the translational potential is often hampered by ever increasing demands on safety, efficiency, regulations and costs. Investigators, researchers, clinicians and policy-makers should critically assess the challenges posed, whether they are practically feasible and if they can be realistically addressed. At its core, science is about observing natural phenomena and developing methods of enhancing or correcting the observation, commonly for the betterment of mankind as a whole. However, science is a progressive field rather than an absolute and as such, the best techniques and evidence today compose the foundation of better research and applications in the future. Therefore,

<http://dx.doi.org/10.1016/j.jot.2017.05.005>

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we need to critically analyse our current evidence to determine if we are continuing to place patients' well-being at risk when we have current techniques to minimise or possibly eliminate the imposed risks. Stem cell and regenerative medicine is a relatively novel field and almost all current clinical applications remain in trial phases. As with all novel research, it is met with caution, particularly by the public who may be misled by subjective press reports and poor studies leading to mistrust of all research conducted in the field [11]. No scientist can claim perfection, but rather they should remain objective and skeptical, by acknowledging what is currently known, what has yet to be elucidated, acknowledge previous errors in the field, remain skeptical of their own findings, do not overvalue their research and potential applications, and embrace novel findings even if they contradict their own understanding; however, these practices should only be conducted with the intent of aiding patients and doing no harm. In order for this field to continue to thrive in future decades, we need to maintain an open mind and enthusiasm. The future for stem cell therapy and regenerative medicine is now!

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding/support

The work was partially supported by grants from National Natural Science Foundation of China (81371946 and 81374568); Hong Kong Government Research Grant Council, General Research Fund (470813, 14119115 and 9054014) and grants from China Shenzhen City Science and Technology Bureau (GJHZ20140419120051680 and JCYJ20150630165236960). This study was also supported in part by SMART program, Lui Che Woo Institute of Innovative Medicine, The Chinese University of Hong Kong.

Acknowledgements

Chelsea Hopkins for her help with English editing.

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Gang Li, Prof., Associate Editor,
*Department of Orthopaedics & Traumatology, Li Ka Shing
 Institute of Health Sciences, The Chinese University of
 Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong,
 China*

E-mail address: gangli@cuhk.edu.hk