Stem Cell Therapy in Sports Medicine

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Over the last few years stem cells have attracted the interest of researchers who try to provide the basis for tissue engineering and regenerative medicine (1,2). It has been demonstrated that damaged tissues produce signals which induce the migration of mesenchymal stem cells into the damaged tissue and probably play a role in regeneration of the respective tissue. Therefore, a lot of research emphasis is put into the newly evolving field of human regenerative medicine. Despite the plethora of published studies, up to now evidence is still lacking and clinical implication of stem cell therapy is actually limited in humans. However, published studies have demonstrated key issues that still need to be addressed in order to put experimental studies into clinical practice.

The term 'stem cell' can be applied to a remarkably diverse group of cells, which share two characteristic properties. A capacity for prolonged or unlimited self-renewal under controlled conditions and the potential to differentiate into a variety of specialized cell types (3). Two rough types of stem cells include embryonic stem cells and adult stem cells. Embryonic stem cell research is mainly performed in animals and clinical applications are not feasible due to their in vivo teratogenic degeneration. Key feature of embryonic stem cells is their potential to contribute to any tissue type of the body but the main disadvantage is the potential to form a teratoma consisting of tissues from all three germ lines (4). Apart from their in vivo uncontrolled proliferation, their potential for immune rejection and ethical concerns related to their clinical application remain major obstacles.

Adult stem cell research has demonstrated research questions that need to be answered in order to implement stem cell therapy based on the principles of evidence based medicine. One of the fundamental questions is the optimal number of cells that would need to be injected in order to achieve optimal results (5, 6). Research on cartilage regeneration has shown that excessive number of mesenchymal stem cells injected into the joint can lead to the formation of free scar tissue within the joint, which might have adverse effects on cartilage regeneration. Tissue derived stem cells show different morphology and they probably display different stem cell phenotypes. Evidence that the variable stem cell phenotypes (7) are qualitatively and quantitatively comparable is still missing. Mesenchymal stem cells derived from different sources may have different properties and it is necessary to define the best source (8)depending on the intended treatment.

The hypothesis that stem cells are not a confounding factor still remains to be accepted. It has to be proven that the effect of cell based treatment regimes is in fact caused by the administered stem cells and not by any other cells or biological factors applied simultaneously (9). It is yet unclear whether stem cells really functionally incorporate into the tissue that requires regeneration or whether they excite a conducting role recruiting and controlling resident cells to regenerate the respective tissue (1,10). It has to be investigated whether they synthesise and secrete growth factors which in turn promote tissue regeneration (1).

Appropriate differentiation of stem cells requires both the introduction of mesenchymal stem cells into the tissue which contains the required cell type and the adequate mechanical environment (11). Research on stem cell treatments for equine tendon or ligament lesions have shown that tensional mechanical load is necessary for an optimal formation of organised tendon and ligament matrix. In addition the time of cell injection plays an important role in the success of the treatment and it is

suggested that the optimal time for implantation of mesenchymal stem cells is 1–2 months after injury, when a suitable granulation bed has formed and before fibrosis is dominating.

In summary, it can clearly be said that in the future a lot of effort still needs to be put into all fields of stem cell research in order to achieve a true stem cell therapy. Translational studies need to be conducted with the appropriate sample size in order to clarify whether stem cell therapy provides a medically useful effect in large patient populations that have some variability in the degree of injury severity. Animal trials will then play a major role in preclinical and first clinical phases of human medical trials. It is important to highlight that in the future stem cells may revolutionise the treatment of a large variety of injuries in sports medicine but any kind of stem cell therapy advertised at the moment for humans is just misleading or even harmful. In the era of evidence based medicine this key point must be disseminated to professional athletes who are always willing to try anything that will help them play or enhance their performance.

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