J. of Cardiovasc. Trans. Res. (2017) 10:91–92
DOI 10.1007/s12265-017-9749-x

EDITORIAL

Tissue Engineering—Bridging the Gap

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Published online: 12 May 2017

Langer and Visconti first suggested the concept of generating new tissues or organs from living cells seeded onto appropriately configured scaffolds in 1993 [1]. As for many other tissues, the potential benefits of tissue engineering were soon recognised by clinicians and researchers seeking new and effective treatments for cardiovascular disease. As this work has advanced, it has brought together a new research community comprising of biologists, engineers, material scientists and clinicians, whose work has progressed from *in vitro* cell culture studies to *in vivo* studies in animal models. Sufficient progress has now been made, such that many projects are ready for translation into the clinical arena. These include the development of vascular tissue for use as bypass grafts, heart valves, myocardial patches and, potentially, a whole functioning heart. This issue of the *Journal of Cardiovascular Translational Research* is focused on cardiovascular tissue engineering with respect to translating advances made in laboratory-based studies into functional tissues with clinical efficacy.

These papers include review articles that address the progress in cardiac repair and vascular tissue engineering and issues relating to the scaling-up of stem cells by recreating a 3D *in vitro* model of the cardiac niche [2, 3]. The challenges in translating the data from pre-clinical and clinical pilot trials that will ultimately be faced by all tissue engineering projects are also reviewed [4]. The experimental studies in this issue address a variety of topics within the heart valve field including two papers on the development of decellularised valves [5, 6], the chemical fixation of bovine pericardium and the assessment of a new transcatheter heart valve [7, 8]. Within the vascular field, there are two papers, the first addresses the use of an *in vivo* approach that utilises the host reaction to an implanted biomaterial for the generation of completely autologous tissues, while the second examines the use of intravascular echo as a tool to evaluate the changes within tissue-engineered valves implanted into sheep [9, 10]. Engineered tissues can also be used to mimic and study normal and diseased conditions. In this respect, the issue contains a paper that models cardiac fibrosis *in vitro*, in an attempt to provide a system in which new avenues for therapy can be assessed [11].

The original paradigm of an implantable tissues comprising of a scaffold material populated with cells *in vitro* may not now be the most practical way forward, due to requirements of compliance to regulatory standards and the cost of commercialising such approaches. There is now a move towards an *in situ* tissue engineering approach where scaffolds are populated by cells after implantation into the patient [12, 13]. This approach is feasible with heart valves and vascular tissue [14, 15]. Whether such scaffolds are based in synthetic or biological (such as decellularised tissue) materials remains to be determined. The key to these strategies will be to replicate the function of the native extracellular matrix (ECM) on scaffold material, such that the scaffold is able to attract and be populated by the desired cell phenotypes and that the physiological communication between cells and the ECM that exist in living tissues is recapitulated.

Bridging the gap between laboratory and clinic will certainly not be easy and not without disappointment for some. However, many of the strategies that are currently being pursued offer real potential to make from the bench to the bedside.

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