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Guest Editorial: Vascularization in Tissue Engineering

Laxminarayanan Krishnan

Parker H. Petit Institute for Bioengineering and Bioscience, Georgia Institute of Technology; 315 Ferst Dr. NW, Atlanta, GA 30332; lkrishnan@gatech.edu

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Adequate vascular perfusion is a critical factor in tissue regeneration. Several strategies ranging from biomaterial scaffolds, growth factors, and cell delivery, including stem cells and vascular precursors, have been used to promote new blood vessel growth. Encouraging neovascularization and increasing local vessel density remain the focus in addressing ischemia or in engineering tissue constructs; but the importance of effective perfusion, response to physiologically relevant stimuli, and microvascular remodeling (angioadaptation) are now receiving consideration.[1–7] Mural cells support and stabilize microvascular structures, particularly during maturation of neovessels during angiogenesis, and they are also thought to be involved in other functions ranging from regulation of flow to regeneration.[8–12] Many studies have already demonstrated the benefits of including support cells in co-culture with endothelial cells in the formation of engineered microvascular structures.[13–18] From a tissue engineering perspective, it is interesting that perivascular cells may also impart tissue-specific characteristics to the microvascular bed.[19] Further, microvascular stabilization has also been proposed in relation to cancer therapy to "normalize" aberrant vasculature, and may additionally open avenues to treat other diseases with microvascular dysfunction.[20–22] The three reviews in this series cover cardiovascular repair strategies in varying depths, provide insights into the status of the field, and explore some of the future directions for engineered tissues as well as for therapies focused on correcting the underlying microvascular dysfunction. Wang et al.[23] provide a concise review of the efforts in improving perfusion using cells and growth factors, the use of natural and synthetic scaffolds, including decellularized myocardium, and the use of complex bioreactors, for cardiac tissue engineering (Issues 5–6, Page 455). An engaging and timely commentary on the need for uniform standards in tissue-engineered therapeutics is also provided. LeBlanc et al.[24] discuss the coronary microvasculature in the pathophysiology of myocardial ischemia in their review of the field, and highlight relevant clinical facets of coronary microvascular dysfunction, the diagnostic and therapeutic challenges, current state of experimental treatments, and the role of animal models in investigating these therapies (Issues 5–6, Page 473). Sun et al.[25] explore interactions of microvasculatures and their perivascular cells in relation to vessel stability and maturity, both in pathologies as well as in revascularization strategies aimed at repair and regeneration, and also discuss the importance of formation of hierarchical or organized vascular structures in engineered tissues (Issues 5–6, Page 433). Overall, this collection of three articles explores relevant techniques and considerations for engineering vascularized tissues, promoting microvascular stability, and provides an important discussion on the need for quality standards as we consider clinical translation of experimental therapeutic strategies.

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