In vivo advanced cardiac imaging in small animals

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In vivo assessment of heart function in animal models, particularly mice, is essential to refining our understanding of cardiovascular disease processes. Ultrasound echocardiography has emerged as a powerful, noninvasive tool to serially monitor cardiac performance and map the progression of heart dysfunction in murine injury models. Speckle-tracking imaging (Strain), in particular, has become an accurate and versatile imaging modality to visualize the cardiovascular system in normal or abnormal conditions. Technical improvements have enabled the transfer of strain analysis to small animal research, and as such made this non-invasive and versatile technique available to provide insights into cardiac anatomy, regional wall motion, myocardial viability, cardiac function assessment, assessment of myocardial infarction, and myocardial injury. In particular, myocardial strain analysis is ideally suited to evaluate therapeutic efficacy for cardiac regeneration. Several studies demonstrated that effectiveness of direct injection of cardiac stem cells (CSCs) is limited in humans by the hostile cardiac microenvironment and poor cell engraftment; therefore, the use of injectable hydrogel or pre-formed patches have been strongly advocated to obtain a better integration between delivered stem cells and host myocardial tissue. Despite the promising features of these stem cells' delivery systems, engineered patches and injectable hydrogels show several limitations for tissue regenerative purposes and in particular their potential deleterious effects per se on cardiac inflammation and function. Here I will discuss myocardial strain applications to evaluate cardiac function and inflammation after novel hydrogel application for innovative tissue engineering regenerative approaches.