Novel Basic and Translational Approaches in Heart Valve Engineering: Insights from Biomechanics and Regenerative Medicine

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Friday, January 13
12:00-1:00 PM
AME N715

Abstract: Valvular heart disease is the next cardiac epidemic causing a great burden worldwide. The current available options for replacement of the diseased valves are limited to mechanical and bioprosthetic (including transcatheter) valves; each has major limitations. Additionally, none of these valves has the ability to self-repair and remodel. Heart valve tissue engineering aims to overcome these limitations either through classical in-vitro or the newly introduced in-situ approaches for creation of living autologous tissue replacements. Despite the early encouraging results, tissue engineered heart valves are too far from clinical practice due to their short term durability and their progressive deterioration that leads to regurgitation and/or leaflet thickening a few months after implantation. To address these issues, the failure modes of the current commercial and tissue engineered valves had to be first studied in greater detail. Then, we approached the problem fundamentally different by introducing hybrid heart valve technology based on a non-degradable scaffold improves valve durability, avoids tissue shrinkage, and accordingly prevents regurgitation. We believe this approach to engineering heart valves require several heart valve replacement procedures over a lifetime.

During this presentation, I will mainly focus on our hybrid heart valve technology, going over different aspects of its development and testing. Furthermore, I will briefly discuss my other accomplished research projects on heart valve engineering and biomechanics.

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