

Mechanical Environment of the Aortic Valve and Mechanobiology

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Abstract : The aortic valve (AV) is a complex mechanical environment that includes flexure, tension, pressure and shear stress forces to blood flow during cardiac cycle. This mechanical environment regulates AV tissue structure by constantly renewing and remodeling the phenotype. In vitro, ex vivo and in vivo studies have explained that pathological states such as hypertension and congenital defects like bicuspid AV (BAV) can potentially alter the AV's mechanical environment, triggering a cascade of remodeling, inflammation and calcification activities in AV tissue. Changes in mechanical environments are first sent by the endothelium that induces changes in the extracellular matrix, and triggers cell differentiation and activation. However, the molecular mechanism of this process is not very well understood. Understanding these mechanisms is critical for the development of effective medical based therapies. Recently, there have been some interesting studies on characterizing the hemodynamics associated with AV, especially in pathologies like BAV, using different experimental and numerical methods. Here, we review the current knowledge of the local AV mechanical environment and its effect on valve biology, focusing on in vitro and ex vivo approaches.

Keywords : aortic valve mechanobiology, bicuspid calcification, pressure stretch, shear stress

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