

C4. Vagus Nerve Stimulation Reduces Anterior Mitral Leaflet Stiffness In The Beating Heart

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OBJECTIVES: The functional-significance of autonomic innervation of the anterior mitral valve leaflet (AMVL) is unknown. We measured AMVL stiffness in the beating heart, testing the hypothesis that remote stimulation of the vagus nerve changes AMVL stiffness.

METHODS: Seven sheep had radiopaque-markers implanted: 13 silhouetting the LV, 16 on the mitral-annulus, 16 on the AMVL, and one on each papillary muscle tip. 4-D marker coordinates were obtained using biplane videofluoroscopy. Finite element (FE) models of the AMVL were developed during isovolumic-contraction (IVC) and isovolumic-relaxation (IVR) before (CNTL) and immediately after vagal stimulation (VNS) (4.0-6mA). Leaflet displacements were simulated in silico using measured LV and LA pressures in FE-models and response functions were computed as the difference between simulated and measured displacements. Circumferential and radial elastic moduli were varied until the response function reached a global minimum. These were interpreted as the in vivo stiffness of the AMVL during IVR and IVC.

RESULTS: VNS reduced heart rate: 94 ± 9 vs. 82 ± 13 min⁻¹, $p=0.006$. In four sheep, AMVL-stiffness fell by 13-40% from CNTL (figure). Heart rate fell in the other 3 sheep after VNS (HR 98 ± 11 vs. 82 ± 16 min⁻¹, $p=0.05$), but AMVL stiffness was unchanged ($p=ns$).

CONCLUSIONS: The AMVL contains contractile tissue, which likely is one basis for AMVL stiffness and explains how its stiffness changes between IVR and IVC. For the first time, we demonstrated a potential role for parasympathetic innervation of the AMVL— to decrease leaflet stiffness. These findings support the concept of a central neural control system that can alter leaflet stiffness to adapt to rapid changes in hemodynamic demands.

Figure:

Leaflet

Stiffness

Values

(n=7)



