Basic Science - Arrhythmias

Repolarization characteristics indicate electrical instability in ventricular arrhythmia originating from papillary muscle

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Introduction: Cardiac arrhythmia originating from the papillary muscle can trigger ventricular fibrillation and cause sudden cardiac death even in the absence of structural heart disease. Yet, no clinical parameters are known to reflect the propensity of arrhythmia to degenerate into ventricular fibrillation.

Purpose: We aimed at identification of parameters associated with degeneration of ventricular arrhythmia into ventricular fibrillation.

Methods: Ventricular arrhythmia was induced by aconitine injection into the papillary muscle of healthy sheep (n = 12) in an open-chest model. Endocardial high-density-mapping and epicardial mapping were performed. We determined repolarization time and activation-recovery-interval according to the Wyatt method.

Results: During focal arrhythmia faster conduction occurred in longitudinal and basal direction than transversal and apical direction. The electrical restitution curve, modelling relation of diastolic interval and activation-recovery-interval, is steeper in aconitine-induced ventricular arrhythmia than in ventricular pacing or sinus rhythm. Steeper restitution curves reflect electrical instability and propensity to degenerate into ventricular fibrillation. The repolarization-related parameters activation-recovery interval and repolarization time exhibit higher heterogeneity per beat in ventricular arrhythmia preceding degeneration into ventricular fibrillation. Repolarization time in relation to cycle length (RT/CL), which can easily be measured during electrophysiological procedures, differentiates self-limiting from degenerating arrhythmia with high specificity and sensitivity.

Conclusion: In structurally normal ovine hearts, the ratio of repolarization and cycle length (RT/CL) in ventricular arrhythmia and greater dispersion of repolarization are indicators of subsequent degeneration into ventricular fibrillation. While dispersion of repolarization is not easily acquired in clinical routine, a simple index (RT/CL) may be sufficient to differentiate between self-limiting and electrically instable arrhythmia with propensity to degenerate to ventricular fibrillation.

Abstract Figure. Repolarization in VA model