

Relationship between Action Potential Alternans and Conduction Block in Anisotropic Canine Atrial Tissues

Kenichi Ota, Motoki Hara, Takahiro Koura, Yasumasa Okada, Koki Hoshiyama, Hideo Mitamura, Satoshi Ogawa, Keio Univ, Tokyo Japan

Action potential duration (APD) alternans occurs at high pacing rates. With increasing pacing rate, concordant alternans first occurs and then is transformed into discordant alternans, producing spatial gradients of repolarization. Thus, discordant alternans is thought to be a cause of conduction block. We examined the relationship between action potential (AP) alternans and conduction block in anisotropic atrial tissue, and found that discordant alternans can occur as a result of conduction block.

METHODS AND RESULTS: Right atrial free wall was dissected from 10 beagle dogs (6-10 years old). Using a voltage sensitive dye and high-resolution video imaging (5400 pixels, 300fr/sec), AP propagation was mapped in a small area (2.8x4.2mm) of the atrial epicardium where fiber orientation was parallel, during pacing with a thin unipolar electrode (100 μ m in diameter). Concordant repolarization alternans was observed when cycle length (CL) was reduced to about 200ms. APD was long when the preceding diastolic interval (DI) was long, and short when DI was short. At shorter CLs, depolarization alternans also appeared. AP amplitude was small when DI was short, and large with long DI. Transverse block was observed during rapid pacing at CLs less than 150ms. Concordant but not discordant alternans preceded the occurrence of conduction block. Conduction block occurred at the beat of small AP amplitude with short DI. When transverse block occurred, it took a long time for the sites distal to the block line to be excited due to the detour of propagation. This made DI longer at the sites distal to the block line. At the next beat without conduction block, DI and APD at the sites proximal to the block line were long, while they were short at the sites distal to the line. Thus, discordant alternans was initiated. Long-short APD alternation and short-long APD alternation coexisted across the line where conduction block occurred.

CONCLUSIONS: In anisotropic atrial tissues, conduction block occurred during concordant alternans, and the occurrence of conduction block initiated discordant alternans. This is a new mechanism for the transition from concordant to discordant alternans.