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K_{ATP} channel opening accelerates and stabilizes rotors in a swine heart model of ventricular fibrillation

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Aims The mechanisms underlying ventricular fibrillation (VF) are still disputed. Recent studies have highlighted the role of K_{ATP}-channels. We hypothesized that, under certain conditions, VF can be driven by stable and epicardially detectable rotors in large hearts. To test our hypothesis, we used a swine model of accelerated VF by opening K_{ATP}-channels with cromakalim.

Aims

The mechanisms underlying ventricular fibrillation (VF) are still disputed. Recent studies have highlighted the role of KATP-channels.We hypothesized that, under certain conditions, VF can be driven by stable and epicardially detectable rotors in large hearts. To test our hypothesis, we used a swine model of accelerated VF by opening KATP-channels with cromakalim.

Methods and results

Optical mapping, spectral analysis, and phase singularity trackingwere performed in eight perfused swine hearts duringVF. Pseudo-bipolar electrogramswere computed. KATP-channel opening almost doubled the maximum dominant frequency (14.3+2.2 vs. 26.5+2.8 Hz, P , 0.001) and increased the maximum regularity index (0.82+0.05 vs. 0.94+0.04, P , 0.001), the density of rotors (2.0+1.4 vs. 16.0+7.0 rotors/cm2×s, P , 0.001), and their maximum lifespans (medians: 368 vs. ≥3410 ms, P , 0.001). Persistent rotors (≥1movie ¼ 3410 ms) were found in all hearts after cromakalim (mostly coinciding with the fastest and highest organized areas), but theywere not epicardially visible at baseline VF. A 'beat phenomenon' ruled by inter-

domain frequency gradients was observed in all hearts after cromakalim. Acceleration of VF did not reveal any significant regional preponderance. Complex fractionated electrograms were not found in areas near persistent rotors.

Conclusion

Upon KATP-channel opening, VF consisted of rapid and highly organized domains mainly due to stationary rotors, surrounded by poorly organized areas.A‘beat phenomenon’ due to the quasi-periodic onset of drifting rotorswasobserved. These findings demonstrate the feasibility of aVF driven by stable rotors in hearts whose size is similar to the human heart. Our model also showed that complex fractionation does not seem to localize stationary rotors.

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