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Line-defect spiral pattern formation during unstable spiral wave propagation in cardiac tissue JUAN RESTREPO, ALAIN KARMA, CIRCS, Northeastern University — Spiral waves of voltage signaling in cardiac tissue are widely recognized to play an important role in the genesis of lethal heart rhythm disorders. Previous modeling studies have shown that the breakup of such waves, which has been proposed as a mechanism for heart fibrillation, can be mediated by a generic period doubling bifurcation. This bifurcation leads to beat-to-beat changes of action potential duration, and hence cellular refractoriness, known as alternans. Here we study the spatial pattern of the period two dynamics before spiral breakup. We find numerically that the line defects, the locus of all points where the dynamics has period one, can form either as a one- or a three-arm spiral pattern where each arm corresponds to a line defect emanating from the spiral core. Three-arm spirals form even when the spiral tip is meandering and lead to a greater dispersion of cellular refractoriness that is proarrhythmic. Analytical results are presented that shed light on the conditions for the formation of one- and three-arm line-defect spirals in the absence of meander.

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