Time Course and Spatial Distribution of T Wave Alternans Induced by Artery Occlusion in Pigs

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T-wave alternans (TWA) has been linked to increased vulnerability of the myocardium to ventricular fibrillation in different clinical conditions, including myocardial ischemia and infarction. TWA induced by acute ischemia has been characterized in patients during balloon occlusion in PTCA [Martínez et al. 2006, IEEE TBME 56(4) pp. 701-711], which constitutes a good model for the first minutes of acute ischemia. Our aim in this work is to study and characterize TWA in longer occlusions using an animal model of myocardial ischemia/infarction. Infarction was induced in 29 pigs by a 40-minute-long balloon inflation on the left anterior descending (LAD) coronary artery. The occlusion recording, as well as a previous baseline recording were analyzed using the Laplacian Likelihood Method together with Periodic Component Analysis, providing multilead TWA detection and amplitude estimation. Significant TWA was found in 27 out of the 29 records (93.1%), while only 2 baseline records presented TWA (6.9%). When observing the individual time-course of TWA amplitude, the most common pattern is one with two peaks, the first attaining the maximum at 5 to 7 minutes of occlusion, and the second around 15-20 minutes from the beginning of occlusion. When averaging TWA amplitude in all occlusions, TWA increased up to a first maximum of 32 uV at 5 min, then reduced and increased again to achieve the absolute maximum at 12 minutes of occlusion (90 uV). After 24 min of occlusion, TWA returned back to the level of the first 2 min. Analysis of the TWA amplitude distribution in the 12 standard leads revealed that maximum TWA appears in leads V3 and V4, those facing the anterior ventricular wall. This is consonance with results obtained in humans during PTCA in LAD. In conclusion, we have studied the prevalence, time course and spatial distribution of TWA during the first 40 min of infarction induced by LAD artery occlusion. The results of spatial analysis were coherent with the regional nature of TWA, while a typical two-peaked temporal pattern has been identified, whose relation with the propensity to arrhythmias should be further studied.