Introduction

It has been well established that repolarization alternans (Re-ALT), a beat-to-beat alternation of action potential duration, is a mechanism facilitating dispersion of repolarization, wavebreaks and reentry (Pastore et al., Circ 99).

We recently observed in human left atrium (Fig 1) periods of intermittent 1:1 and 2:1 atrial capture preceded by atrial Re-ALT and decreased excitability (i.e. prolongation of activation time, AT) during rapid pacing. This observation suggests that decreased excitability may play a protective role against rapid pacing-induced Re-ALT and atrial reentry.

Hypothesis

We hypothesized that decreased excitability plays a protective role against Re-ALT induced arrhythmias by facilitating periods of intermittent capture during tachycardia.

Methods

• Two pacemakers (PM), each with a lead screwed into the right atrium, were implanted in 13 sheep:
  - 1st PM: recording of single broadband (800 Hz, 0.4 Hz high pass filter) unipolar atrial electrogram (EGM).
  - 2nd PM for delivery of customized electrophysiology protocols including atrial pacing for 400 beats (S1-S2) starting at a cycle length (CL) of 400 ms with 10 ms decrement until loss of 1:1 atrial capture.
• Parameters analyzed from EGM until the 1st beat of 2:1 atrial capture:
  - Activation time (AT) - time interval from the pacemaker stimulus to the atrial R peak
  - Activation recovery interval (ARI) - time interval from the atrial R-wave peak to the apex of the T-wave
  - Re-ALT (ΔTa) - beat-to-beat differences in atrial T-wave apex amplitude

Results - 1

1. Intermittency of atrial capture

Similarly to human findings, intermittent 2:1 atrial capture (Fig 2) was observed in all sheep (n=9) at a mean pacing CL of 156±26 ms, but no periodicity was noticed.

2. Activation and repolarization dynamics prior to 2:1 capture

179 transitions from 1:1 to 2:1 capture were analyzed from 11 sheep. Figure 3 shows representative recordings prior to 2:1 atrial capture exhibiting the four different patterns with their unipolar EGM and corresponding AT and ΔTa time series. Atrial EGMS display 1:1 atrial capture until the first non captured beat (arrow).

Conclusions

• Using an ovine model of rapid atrial pacing mimicking pulmonary veins tachycardia, Re-ALT and decreased excitability (as assessed by AT prolongation) in 56% of the episodes. Only 10% showed neither changes in AT nor Re-ALT (type D).

• These findings suggest that decreased excitability may play a protective role against pro-arrhythmogenic effect of rapid pacing-induced Re-ALT.

• Because rapid atrial tachycardia slows propagation velocity and promotes fibrillatory conduction, transitions to 2:1 capture may reduce susceptibility to atrial fibrillation.