Device algorithm interaction resulting in loss of biventricular pacing in CRT

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Introduction: 46 yrs. gentleman with recurrent heart failure due to dilated cardiomyopathy was implanted CRTP (Abbott). LV lead was placed epicardial due to inability to deliver coronary sinus venous lead endocardially. On routine follow up noted to have multiple counts of AMS (Automatic mode switch) resulting in temporary loss of biventricular pacing. Apart from this the lead parameters are normal.

Methods: Not Applicable

Result: On evaluation of the AMS, we found an interesting phenomenon that the AMS episodes were not triggered by any atrial arrhythmia. Rather there was prior automatic shortening of programmed sensed AV delay (SAV) from 100ms to 20ms. Normally, there was far field R wave (FFRW) sensing in the atrial channel which fell into PVAB (post ventricular atrial blanking period). The FFRW sensing mostly depends on sensing of R waves from RV by lead in RA. With SAV shortening, the FFRW did not advance and fell outside the PVAB but into PVARP and was counted as an atrial event but not tracked. This erroneous counting of atrial events resulted in reaching the AMS set state of 180 atrial events per minute and triggered the AMS. The AMS resulted in changing into DDI mode and AS VS pacing. Here the sudden decrease of sensed AV delay was due to periodic checking of lead threshold by LV cap confirm algorithm by the device which in turn triggered the AMS episodes. There is decrease of sensed AV delay in LV cap confirm to ensure that intrinsically conduction QRS doesn't interfere with threshold testing. The cause of nonadvancement of FFRW is the late activation of RV from LV in presence of LBBB and need for transseptal conduction. LV cap confirm is an algorithm to automatically measure LV threshold and adjust pacing amplitude according to it. Far field R wave (FFRW) oversensing depends on the relative amplitudes of atrial EGM and FFRW, the timing and gap between them and the variability of oversensing FFRW. FFRW can be managed by increasing atrial sensitivity in patients with AEGM:FFRW ratio > 2:1. In St Jude devices, the decay delay can be reduced, and initial sensitivity threshold can be increased to avoid FFRW. If all these are not successful, the PVAB (post ventricular atrial blanking) period can be increased. In this case, the AEGM: FFRW ratio was > 4:1. Hence the atrial sensitivity was increased which resulted in no more AMS episodes after that.

Conclusion: Device algorithms for automatic threshold testing in CRT can occasionally lead to erroneous triggering of safety algorithms like AMS and can result in loss of biventricular pacing. Device manufacturers should take care that triggering of AMS should not occur if the device itself is running some tests. Also, there should be labelling of the threshold tests in the EGM from the device so that the physician can easily make out the cause of such phenomenon.