Ventricular Tachycardia and Fibrillation Detection In Implantable Cardioverter—Defibrillators

Wednesday, March 22, 1995, 9:00 a.m.–11:00 a.m. Ernest N. Morial Convention Center, Hall E Presentation Hour: 10:00 a.m.–11:00 a.m.

992-108 Redetection of Ventricular Fibrillation after a Failed First Shock in Transvenous Defibrillator Lead Systems


Redetection (RD) of ventricular fibrillation after a failed first shock may be delayed. Although algorithms in individual devices (ICD) differ, criteria for RD are uniformly less stringent than for initial detection of ventricular fibrillation (DET). If failed first shocks have no adverse effect on sensing performance, then the time required for RD should be less than that for DET; that is, the RD time minus DET time (RD-DET) should be consistently >0. The mean RD time (159 RD episodes, 70 pts) was 4.3 ± 2.2 sec. Individual episodes of prolonged RD, defined as > mean + 2SD (>8.7 sec), were also identified.

ICD
Pts RD-DET (sec) p (RD>DET) RD > 8 sec
Cadence (Endotak 60) 28 -0.9 ± 3.3 NS 7
Ventak-P (Endotak 60) 16 1.3 ± 2.6 NS 4
Jewel-Transvene 13 -1.8 ± 0.7 0.0001 0
Cassidian-TLV 10 -1.8 ± 0.9 0.0001 0
All Endotak 60 44 -0.1 ± 3.2 NS 11
All other leads 26 -1.7 ± 0.8** 0.0001 0

** RED-DET Endotak 60 vs all other leads p = 0.018

In ICD systems that allowed analysis of the sensed electrogram, prolonged RD episodes consistently demonstrated substantial variation in signal amplitude during post-shock ventricular fibrillation.

Conclusions: In ICDs coupled with leads other than the Endotak 60 lead: 1) RED time was significantly < DET time and 2) prolonged RD times were not seen during testing conditions against induced ventricular fibrillation. Although the clinical significance is unclear, these data have important implications for lead design and device programming.

992-109 Prolonged Redetection of Ventricular Fibrillation with an Integrated Lead System

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Integrated defibrillator leads incorporate both sensing electrodes and a shocking coil in the ventricle. Although this facilitates lead system placement, sensing may be impaired because of the high energy electric fields close to the sensing electrodes. To evaluate this, we prospectively compared sensing in 55 patients (pts) who received an Endotak 60 lead with those who received either a dedicated sensing lead or a lead without ventricular coils (CPI BT-10, BT) or an integrated lead (CPI Endotak, ET). VF was induced with ramp pacing from a temporary pacing catheter and sensing was automatically performed by the defibrillator (Ventak 1600). Redetection was assessed from a failed first shock just below defibrillation threshold. Mean patient age (64 yrs) and mean LVEF (33%) did not significantly differ between the two groups. Results are shown below (mean ± SD).

Type of lead N Detect time (sec) Redect time (sec)*
BT 32 3.2 ± 1.8 3.6 ± 2.6
ET 23 2.3 ± 3.8 5.4 ± 3.5

* P < 0.05 between the two types of leads

Redetection revision (>6 sec) was found in 26% of pts with ET compared to 6% in pts with BT (P < 0.05). Redection following a sub-therapeutic shock without ventricular coils (CPI BT-10, BT) or an integrated lead ICPI Endotak, Cadence-Endotak 60 -0.9 ± 3.3 NS 7
Ventak-P-Endotak 60 16 1.3 ± 2.6 NS 4
Jewel-Transvene 13 -1.8 ± 0.7 0.0001 0
Cassidian-TLV 10 -1.8 ± 0.9 0.0001 0
All Endotak 60 44 -0.1 ± 3.2 NS 11
All other leads 26 -1.7 ± 0.8** 0.0001 0

992-111 Minimum Interelectrode Distance to Avoid Interactions Between Coexistent Pacing System and Defibrillator Systems

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The coexistence of a dual-chamber (or ventricular) permanent pacemaker (PM) and a non-thoracotomy (NT) ICD may result in ICD nondetection of ventricular fibrillation. In this study, we examined the shortest distance from the PM electrodes to the ICD sensing electrodes using a three-dimensional coordinate system on PA and lateral chest radiographs. Pts were extensively tested post-implant for potential deleterious device-to-device interaction. In 5 pts (15%), the ICD was inappropriately inhibited by asynchronous ventricular pacing during ventricular fibrillation. This is important in the light of the frequent concomitant use of both devices. Guidelines to avoid this interaction, specifically the minimum safe distance between the 2 electrodes, have not been established. In 33 pts with coexistent PM and NT-ICD, we measured the shortest distance from the PM electrodes to the ICD sensing electrodes. Pts were divided into 2 groups: 1) PM electrodes and myocardium 10.002 and PM electrodes and myocardium 10.002. Results: Minimum interelectrode distance for PM electrodes to the ICD sensing electrodes was significantly shorter than in the “Non-Interaction Group” (1.6 cm vs. 3.4 cm, p = 0.03, Mann-Whitney test). Out of 10 (40%) systems with shortest interelectrode distance <2.0 cm demonstrated interaction, while this occurred in only 1 of 23 (4%) systems with shortest interelectrode distance ≥2.0 cm (p = 0.02, Fisher's Exact test).

Conclusions: 1. A distance of at least 2.0 cm between the PM electrodes and the ICD sensing electrodes will avoid deleterious interactions in the vast majority of pts. 2. The use of at least one active-fixation lead will facilitate achievement of this target interelectrode distance by allowing stable lead positioning in the RV outflow tract or septum. 3. Careful lead positioning does not obviate the need for intra- and postoperative testing to identify potentially life-threatening device-to-device interaction.

992-112 Compromised Time to Shock Therapy In a Noncommitted Transvenous ICD System

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Reduction in electrogram size after an endocardial shock has been associated with sensing problems in some transvenous integrated bipolar shock/sense lead systems. We have previously reported that redetection time (RDT) after a failed defibrillation shock is not prolonged in the 60-series Endotak lead (CPI, St Paul, MN) combined with the Ventak P (committed shock) pulse generator. We performed this study to examine RDT in the noncommitted Ventak P2 using the same lead system. In 25 patients (20 male, 15 with coronary disease) undergoing follow-up testing, 84 episodes of failed defibrillation shock were examined for initial detection time (IDT) and RDT as well as failed arrhythmia reconfirmation during capacitor charge (FTT). Event marker output and telerecorder data were used to analyze each ventricular fibrillation event for detection and reconfirmation excluding the rotor delay and charge time. Mean (±SEM) age was 61 ± 3 and ejection fraction was 31 ± 2%. In seconds (s), IDT was 2.83 ± 0.14 and RDT was 4.01 ± 0.31 (p < 0.0001). There were 7 IDT and 18 RDT events >5s (p = 0.03) and no IDT