**992**  
**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 Defibrillation Lead Systems  
David J. Callans, Uldhoy S. Swarna, David Schwartzman, Charles D. Gottlieb, Francis E. Marchlinski. Philadelphia Heart Institute, Philadelphia, PA

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 > 8.7 sec**

---

**Cadence (Endotak 60)**
- 28  
- 0.9 ± 3.3  
- NS  
- 7

**Ventak P-Endotak 60**
- 16  
- 1.3 ± 2.6  
- NS  
- 4

**Jewell-Transvene**
- 13  
- 1.8 ± 0.7  
- 0.0001  
- 0

**Cadence-TVL**
- 10  
- 1.6 ± 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

**992-109**  
**Prolonged Redetection of Ventricular Fibrillation with an Integrated Lead System**  
Rangarao V. Tummala, Korosh Khalihi, Daniel N. Weiss, Stephen R. Shorofsky, Michael R. Gold. University of Maryland, Baltimore, MD

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 had received either a dedicated sensing 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).

<table>
<thead>
<tr>
<th>Type of lead</th>
<th>N</th>
<th>Detect time (sec)</th>
<th>Redect time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT</td>
<td>32</td>
<td>3.2 ± 1.8</td>
<td>3.6 ± 2.6</td>
</tr>
<tr>
<td>ET</td>
<td>23</td>
<td>2.9 ± 3.6</td>
<td>5.4 ± 3.5</td>
</tr>
</tbody>
</table>

*p < 0.05 between the two types of leads

Prolonged redetection (>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 is longer with integrated ICD lead (ET) utilizing defibrillation coil as part of the sensing circuit. The clinical significance of this finding needs to be assessed.

**992-111**  
**Minimum Inter electrode Distance to Avoid Interactions Between Coexistent Transvenous Pacemaker and Defibrillator Systems**  
Raymond E. Miller, Stephen A. Fahrig, Sergio L. Pirskey. Cleveland Clinic Foundation, Cleveland, Ohio

The coexistence of a dual-chamber (or ventricular) permanent pacemaker (PM) and a non-thoractomy (NT) ICD may result in ICD non-detection of ventricular fibrillation during asynchronous ventricular pacing. This is important in 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 using a tridimensional 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 in this "Interaction Group", the mean shortest distance from the 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). Four 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: A distance of <2.0 cm between the PM electrodes and the ICD sensing electrodes will avoid deleterious interactions in the vast majority of pts. 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. 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**  
David Martin, Adolqui Peraita, Ferdinand J. Venditti Jr, Roy M. John. Lahay Clinic Medical Center, Burlington, MA

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 non-committed 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 recorrection during capacitor charge (FTR). Event marker output and telemetered data were used to analyze each ventricular fibrillation episode for determination of the rotation excluding the rotor (i.e., delayed 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...
and 4 RDT events $\geq$10s. There were 5 FTR events prior to failed shocks, and 19 after such shocks ($p = 0.004$). Mean energy of failed shocks was $10.8 \pm 0.5 J$.

Conclusions: Sensing of VF after a failed shock is significantly prolonged in this ICD system; our data suggest that the requirement for reconfirmation may delay therapy delivery after an initial shock that fails to defibrillate.

**992-113**

### The Role of Tilt Table Testing and Neuromonitoring for Optimal Defibrillator Programming

Igor Singer, Cheryl Williamson, Harvey L. Edmonds Jr. University of Louisville, Louisville, KY

Programming of third generation implantable cardioverter defibrillators (ICDs) is usually based on electrophysiologic (EP) testing in the supine position. However, efficacy and tolerance to tiered therapy for ventricular tachycardia (VT) may not be equivalent in the erect position. To test this hypothesis we studied 9 patients ages 36–72 years with implanted ICDs in the supine and erect position on a tilt table. ICDs were programmed to deliver ATP, cardioversion and defibrillation in the ascending order of aggressivity for hemodynamically stable VTs. Perfusion was assessed by continuous intraarterial pressure and neuromonitoring techniques capable of assessing beat to beat cerebral perfusion (transcranial Doppler (TCD)), oxygen utilization (near infrared spectroscopy (NIRS)) and neuronal function (quantitative encephalography (QEEG)).

Results: 52 episodes of tachyarrhythmias were induced, 30 in the supine and 22 in the erect position. The duration of VT was 12 ± 5 sec in the supine and 17 ± 11 sec in the erect position ($p = NS$). Adequate perfusion was seen with programmed therapy in all patients in the supine but only in 5/9 patients in the erect position. Abnormal response in 4 patients was characterized by subnormal post-hypotensive hyperemic response (≤40% increase in the blood flow velocity post-VT), delta wave slowing on the QEEG, and ≤20% increase in NIRS post-hypotensive episode typical of cerebral ischemia. Of these 4 patients, syncope (2) and seizures (2) were experienced in the erect, but not in the supine position during testing.

Conclusions: 1) Supine testing may not predict optimal ICD therapy. 2) Neuromonitoring techniques are useful to assess cerebral perfusion during ICD testing. 3) Upright tilt should be considered for routine ICD testing to optimize programming.

### Atrial Recordings for the Differentiation of Ventricular and Supraventricular Tachyarrhythmias

Wolfgang Schoels, Laurence D. Sterns, Kirsten D. Freigang, Alex Bauer, Johannes Brachmann, Wolfgang Kübler. Division of Cardiology, University of Heidelberg, Germany

Inappropriate shocks due to supraventricular tachyarrhythmias (SVT) are a major concern in patients with implanted defibrillators. To elucidate the role of atrial recordings for the differentiation of ventricular (VT) and SVT, 127 right and left epicardial atrial electrograms were simultaneously recorded during atrial fibrillation (AF), ventricular fibrillation (VF), and rapid ventricular pacing (VP) at the fastest rate with retrograde 1:1 conduction simulating VT in 4 dogs with sterile pericarditis. Mean atrial (ACI) and ventricular cycle-lengths (VCI) were determined before and during adrenaline infusions (1.0 μg/kg/min). Adrenaline was given to stimulate physical exercise. In 43 ± 10% of all atrial recordings, the atrial signal was contaminated by ventricular activity or tachycardia-dependent complexities of the atrial signal impose a substantial risk of false detections.

Conclusions: Accurate differentiation of VT and SVT even during adrenaline stress. However, superimposed ventricular activity or tachycardia-dependent complexities of the atrial signal impose a substantial risk of false detections.

### 992-115

### Variability of the First Postspacing Interval, A New Algorithm for the Differential Diagnosis of Tachyarrhythmias in Patients with Implantable Defibrillators

Angel Arenal, Jesús Almendral, Julian Villacañas, Juan L. Delcán, Jesús Ma Aiday, Agustín Pastor, Olga Medina, Rafael Peinado. Hospital Gregorio Marañon, Madrid, Spain

In order to differentiate monomorphic ventricular (V) and regular atrial (A) tachyarrhythmias (T), we studied the variability of the first postspacing interval (FPPI) after synchronized pacing trains with different number of beats, delivered at the right ventricular apex (RVA) during T. We hypothesized that changes in retrograde AV nodal penetration in response to changes in the number of paced beats may change the FPPI. In contrast, it is known that pacing trains producing entrainment of VT result in a constant FPPI. The stimulation protocol: sequences of pacing trains of 5, 10, and 15 stimuli, each sequence was repeated 3 times, the pacing cycle length (CL) was 40 ms shorter than the CL VT. Study group: 25 T, 15 AT no accessory pathway related (CL 371 ± 26 ms) and 10 VT (CL 361 ± 53 ms). The FPPI after 5, 10 and 15 beats were different (559 ± 48, 486 ± 143, and 335 ± 77 ms, p < 0.04 ANOVA) during AT, and similar (506 ± 24, 514 ± 26, 515 ± 25 msec) during VT. ΔFPPI (5–10) = difference in the FPPI after trains of 10 and 5 beats. The table shows % of sequences of pacing train.

ΔFPPI (5–10) <30 ms | >30 ms
---|---
AT | 7% | 93%
VT | 90% | 0%

Conclusions: the stability after trains of different numbers of stimuli in the FPPI during right ventricular stimulation may differentiate ventricular from atrial T with a CL longer than 200 ms. This criterion could be potentially useful for the differential diagnosis of tachyarrhythmias by implantable devices.

### 993 The P-Wave and Atrial Fibrillation

Wednesday, March 22, 1995, 9:00 a.m.–11:00 a.m.

Ernest N. Morial Convention Center, Hall E

Presentation Hour: 9:00 a.m.–10:00 a.m.

### 993-39 P-Signal Averaged ECG in the Evaluation of the Risk of Arrhythmic Recurrence in Patients with Paroxysmal Atrial Fibrillation: A Prospective Study

Giovanni G. Villani, Massimo Piepoli, Fabio Traverso, Alessandro Capucci, Cardio Dept. General Hospital, Paracelsus I, London, UK; Cardio Med. National Heart & Lung Institute, London, UK

The P-Signal Averaged ECG (PASECG) has been introduced in the clinical practice to evaluate patients with episodes of lone paroxysmal atrial fibrillation (PAAF) but its role in the prediction of arrhythmic recurrence is still unclear. In a prospective study we assessed the ability of clinical and PASECG parameters in predicting arrhythmic recurrence. In 32 patients (19 M, 44 ± 14y) with at least one documented episode of PAF, filtered P wave duration (PD), P wave duration dispersion index (Pfdi), root mean square voltage of the last 20 msec of the P wave vector magnitude (RMS20), left atrial size (LA, Echo) and age were collected 48 hours after the last PAF episode. A monthly follow-up was performed (8 months/patient) for identifying patients with Group A (10 pts) and without (Group B, 22 pts) PAF recurrence, in order to define the arrhythmic risk predictor values of the considered parameters.

Results:

<table>
<thead>
<tr>
<th>Group</th>
<th>Controls</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>54.4 ± 10.4</td>
<td>58.8 ± 16</td>
</tr>
<tr>
<td>LA (mm)</td>
<td>43.5 ± 2.5</td>
<td>44.1 ± 1.8</td>
</tr>
<tr>
<td>Pd (msec)</td>
<td>140.4 ± 14.9</td>
<td>130 ± 11</td>
</tr>
<tr>
<td>Pfdi (msec)</td>
<td>3.73 ± 3.5</td>
<td>3.56 ± 2.5</td>
</tr>
<tr>
<td>RMS20 (μV)</td>
<td>4.0 ± 2.2</td>
<td>4.6 ± 2.5</td>
</tr>
</tbody>
</table>

In the discrimination between the two groups, PD ≥ 130 msec (p = 0.01) showed 90% sensitivity, 55% specificity, 47% positive and 92% negative predictive values, Pfdi ≥ 4.5 mesc (p = 0.04) 60% sensitivity, 77% specificity, 55% positive and 81% negative predictive values. The combination of these criteria (p < 0.005) showed 60% sensitivity, 91% specificity, 75% positive and 83% negative predictive value. Our results suggest that PASECG parameters may be useful in the evaluation of patients with episodes of PAF and may allow to identify a subgroup of patients at low risk of arrhythmic recurrence.