measured during the last 8 beats of the detected tachycardia episode (TE). A total of 169 TE was obtained from 17 of 44 P (39%). The EGM width was programmed using an individually adapted width threshold interval of 88 ± 12 ms to distinguish between SVT and VT prior to discharge. To determine the duration of the intracardiac EGM, a mean slew rate of 37 ± 6 mV/s was employed. The criterion for VT was met when 6 out of 8 detected QRS complexes of the tachycardia episode exceeded the programmed width interval. During initial follow-up, the width criterion resulted in appropriate VT detection in 5 of 9 P with spontaneous VT and in inappropriate VT detection in 3 of 6 P with SVT and had to be reprogrammed. The results for all episodes are presented in the following table.

Clinical arrhythmia	Wide EGM width ≥ 6 of 8 complexes	Narrow EGM width ≥ 3 of 8 complexes
Induced VT (n = 15)	93%	7%
Spontaneous VT (n = 112)	96%	4%
Spontaneous SVT (n = 42)	24%	76%

Conclusion: Measurement of intracardiac EGM width during tachycardia may improve appropriate arrhythmia discrimination. However, this parameter apparently is not stable in all patients requiring individual adaptation during follow-up.

912-70 The Effect of Simulated Pacing Stimuli on Ventricular Fibrillation Detection by Implantable Defibrillators

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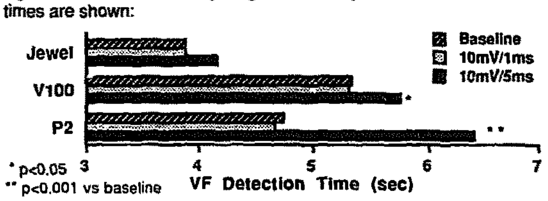
The effect of pacemaker (PM) stimuli on ventricular fibrillation (VF) detection by defibrillators (ICD) has not been formally evaluated. Detection times in 34 VF signals recorded from rate sensing leads in 11 pts were compared before and after the addition of superimposed simulated PM artifact (60 ppm) in three ICD systems: Medtronic Jewel, Ventritex V-100, and CPI P2. The VF signals were acquired using a wide bandpass filter amplifier (HVSO2), recorded on analog tape, and subsequently digitized at 5 kHz. Electronically generated "pacer" square wave impulses with an amplitude of 10 mV and pulse width (PW) of 1 and 5 ms were added to the baseline VF to synthesize composite PM-VF signals. Each ICD was programmed with nominal parameters as a single zone system with VF detection at 350 ms. Baseline VF and PM-VF signals were restored to original gain before input to each ICD. VF detection times are shown:



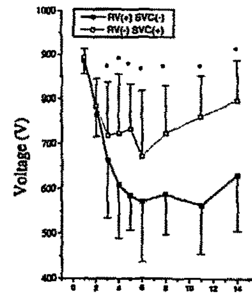
Non-detection was defined as ≥ 10 sec. All baseline VF and PM-VF signals with PW = 1 were detected. Of the PM-VF signals with PW = 5, non-detection occurred in the Jewel 1/34 (2.9%), V-100 1/34 (2.9%), and P2 10/34 (29.4%) ($p < 0.01$).

Conclusion: Inhibition of device sensing by pacer artifact during induced VF in third generation ICD's appears to be infrequent when a relatively narrow pulse width is utilized. Pacing pulse width is an important determinant of pacemaker-ICD interaction.

912-71 Effect of Electrode Polarity on Monophasic Waveforms Using an Endocardial Lead System in Pigs

Jian Huang, Bruce KenKnight, Gregory P. Walcott, Robert G. Walker, William M. Smith, Raymond E. Ideker. *University of Alabama at Birmingham, Birmingham, AL*

Electrode polarity reversal results in improved defibrillation efficacy in some patients and no change in others for monophasic waveforms in which duration varies with the impedance. This suggests waveform duration may contribute to the observed difference. To test this idea, defibrillation thresholds (DFTs) were determined for monophasic exponential waveforms (150 μF) truncated at 1, 2, 3, 4, 5, 6, 8, 11, 14 ms. Strength-duration curves were constructed for both polarities. In eight pigs, two platinum spring electrodes were placed in the RV apex and at the RA-SVC junction. Paired t-test and ANOVA analyses were used to determine the effect of polarity and waveform duration on DFTs. There was no significantly difference in DFT leading edge voltage for 1 and 2 ms monophasic waveforms when the RV electrode was either anode or cathode. However, when waveform duration was 3 ms or longer, waveforms with RV cathode yielded significantly higher DFT voltage requirements than that with RV anode ($p < 0.01$) and the difference in DFTs between each polarity was significantly increased as waveform duration increased.



Conclusion: Transvenous electrode polarity significantly affects DFT for monophasic waveforms greater than 3 ms in duration. Monophasic waveform duration affects the polarity difference in DFTs and may partially explain why some patients exhibit a larger effect than others.

912-72 Ventricular Tachyarrhythmias Occur More Frequently in Winter and Less Frequently in Spring Than in Other Seasons: Report From a Multicenter Implantable Cardioverter Defibrillator (ICD) Database

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To assess monthly and seasonal variations in spontaneous ventricular tachyarrhythmias(VTA), we reviewed the prospectively collected database for a tiered therapy investigational ICD. The study included 282 (241 male, 41 female) U.S. Pts. This device labels the date and time of all VTA's. Of the 1995 episodes noted in the 194 Pts. who had VTA (cycle length = 327 ± 95 ms) a median of 54 days after implant, the most (615 = 31%) occurred in winter (W) and the least in the spring (SP) (325 = 16%), with intermediate results in autumn (A) (560 = 28%) and summer (SU) (495 = 25%) (p = 0.0001 by Poisson regression analysis). These results were not influenced by implant date, use of antiarrhythmic agents, presenting arrhythmia, type of VTA (ventricular tachycardia or fibrillation), climactic differences of implanting sites ("warm winter" site vs "cold winter" site), or the presence of coronary artery disease. Seasonal patterns in females were similar to those in males, although they had more frequent VTA in SU than males (89 episodes = 36.3% vs. 406 episodes = 23.2%). Similarly, the greatest number of VTA/active Pt/month occurred in January (67.5) and March (77.9) and the smallest was in April (40.7, $p < 0.001$). We conclude that Pts with ICD's have marked seasonal variation in the occurrence of VTA's, with the highest frequency in the W and the lowest in SP. The explanation for this observation remains undetermined.

912-73 Efficacy of the First Countershock in Prolonged Ventricular Fibrillation

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Ventricular fibrillation (VF) is usually terminated by a single countershock, if delivered immediately after onset of VF. However, little is known about factors determining efficiency of the first countershock in prolonged VF. Automated defibrillators as used by EMTs during out-of-hospital resuscitations continuously record the patient's rhythm on audio tapes. This allows an analysis of arrhythmia present immediately before and after the first 200-J shock, offering an opportunity to investigate the efficacy of defibrillation in prolonged VF. *Results:* Tape recordings of resuscitation attempts in 284 consecutive pts (age 76 ± 13 years, 31% female) with VF as underlying arrhythmia were reviewed. After the first shock, 131 pts (46%) had persisting VF, 80 (28%) converted into asystole (ASY), 74 (26%) into a regular electric activity (REA). This distribution was independent of age (≤ 65 vs > 65 years), sex, and underlying disease (primary VF vs myocardial infarction vs unclear). Neither call-scene- nor collapse-scene-intervals of ≤ 3 min, 4–5 min, 6–7 min, and > 7 min of the rescue squad had an influence on the effects of the first countershock. However of the 73 pts with REA after the first shock, 70% were admitted to a hospital, compared to only 48% of 80 pts with ASY and 40% of 131 pts with persisting VF ($p < 0.004$). Of the 47 pts surviving >

1/2 year, 49% had REA after the first shock, compared to only 21% with ASY and 30% with persisting VF ($p < 0.0003$). *Conclusion:* In prolonged VF, only 26% of the pts could be converted into a regular rhythm with an initial 200 J countershock. This conversion rate appears unrelated to age, sex, underlying disease, and to the usual response times of rescue services, but is associated with short- and long-term prognosis. Further investigation of characteristics of prolonged VF may aid in the determination of more efficient specific shock forms or energy applications.

912-74 The Effect of Ventricular Fibrillation Duration and a Failed Shock on Defibrillation Thresholds Using Biphasic Waveforms

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Background: While the defibrillation threshold (DFT) has been reported to increase with ventricular fibrillation (VF) duration for monophasic waveforms, the effect of both VF duration and a first failed shock on the DFT using biphasic waveforms has not been investigated. Therefore, a paired comparison of shock strength parameters at ED50 between shocks delivered after 10 sec of VF and after 20 seconds of VF with and without a first failed shock was performed using biphasic waveforms in pigs.

Methods and Results: 8 pigs, implanted with an endocardial lead system, underwent a recursive up-down algorithm for a total of 60 shocks per pig to center most shocks near ED50. Biphasic shocks (6/6 ms) were delivered after 10 sec of VF and after 20 sec of VF with and without a preshock at 10 sec. The result for paired shock strength parameters at ED50 are summarized in the table below:

	10 sec VF	20 sec VF with preshock	20 sec VF without preshock	P-Value
Energy	10.1 ± 2.4 J	7.9 ± 2.4 J	7.5 ± 3.2 J	< 0.01
Voltage	363 ± 42 V	323 ± 45 V	314 ± 60 V	< 0.01
Current	9.8 ± 1.2 A	8.8 ± 0.8 A	8.6 ± 1.6 A	0.02

Conclusions: (1) As opposed to monophasic shocks, energy, voltage and current at ED50 are significantly lower for biphasic shocks delivered after 20 sec of VF as compared to 10 sec of VF in pigs. (2) A first failed shock does not significantly change the DFT using biphasic waveforms in pigs.

912-75 Circadian Variation in First Shock Efficacy of an ICD System

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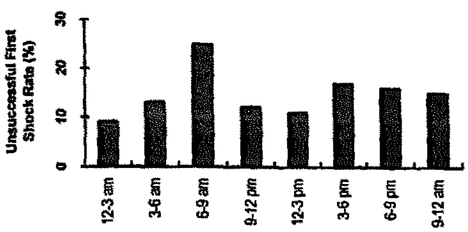
Reports have demonstrated a circadian variation in the incidence of several cardiac events. We have previously reported a morning peak in defibrillation energy requirements. In order to determine if there was a corresponding peak in failed first shocks delivered by an ICD, we reviewed 1,238 episodes of ventricular tachyarrhythmias treated with shock therapy in 930 patients (mean age 62 ± 12 years; 73% had coronary disease) implanted with an ICD system with date and time stamps for each therapy. Stored electrograms and telemetered data were used to confirm ventricular arrhythmia. The mean tachycardia cycle length was 332 ± 84 ms. The failed first shock rate for the total group which was 15% was not distributed uniformly over time. First shocks delivered in the morning had a lower success rate when compared to other times ($p < 0.002$) *(see figure). Peak failure rate was between the* hours of 6–9 am (24.9%) with a nadir between 12–3 am (9%).



We conclude that first shock efficacy for spontaneous arrhythmic events is reduced in the morning hours. This finding supports our previously reported data of a higher energy requirement for successful defibrillation in the morning hours and may have implications for ICD programming.

912-76 P-Wave Discrimination in Intracardiac Electrograms Derived From Defibrillation Leads Depends on the Position of the Superior Vena Cava Electrode

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For differentiation of ventricular vs. supraventricular tachycardia in implantable defibrillators (ICD) the presence of a P-wave and its R-wave relationship is important. Newer ICDs allow the storage of intracardiac bipolar electrograms from the proximal defibrillation electrode (PE) in the superior vena cava (SVC), the distal electrode (DE) in the right ventricular apex and from the tip and ring of the DE. Therefore, we investigated in 22 pts undergoing ICD implantation (Medtronic® 7219D, n = 10, Medtronic® 7220D, n = 12) the presence (PR), duration (D) and amplitude (A) of the P-wave in 4 different electrograms: Tip to ring, tip to DE, ring to PE and DE to PE. Additionally, in 10 pts the PR, D and A were determined at 3 different positions of the PE for DE/PE: low SVC position (at the border of the right atrium = LP), intermediate SVC position (transition to the innominate vein = IP) and high position (innominate vein = HP). *Results:*

	Tip/ring	Tip/DE	Ring/PE	DE/PE
PR/n	2/22	14/22	21/22	22/22°*
D (ms)	24 ± 5.6	45.2 ± 16.1	53.9 ± 15.6#	63.6 ± 16.6#
A (mV)	0.13 ± 0.11	0.27 ± 0.15	0.34 ± 0.18	0.38 ± 0.19

°$p < 0.03$ compared to tip/DE (χ^2), *$p < 0.01$ compared to tip/ring (χ^2), #$P < 0.01$ compared to tip/DE (*t* test)

P wave was present with DE/PE in all 10 pts where different SVC positions were tested. D was longer in LP (105 ± 32.5 ms) vs. IP (96.7 ± 19.7 ms, n.s.) and HP (60 ± 19.4 ms, $P < 0.01$), D in IP was longer than in HP ($p < 0.01$). A was significantly higher in LP (0.92 ± 0.29 mV) vs. IP (0.47 ± 0.15 mV, $P < 0.05$) and HP (0.28 ± 0.08, $P < 0.02$), A in IP was higher than in HP ($p < 0.02$).

Conclusions: 1) For this ICD system P wave detection and size is optimal in the ring/PE and DE/PE electrograms. 2) A and D are significantly higher with IP compared to HP and A is significantly higher with LP compared to IP for DE/PE. 3) For optimal P wave detection the PE should be implanted in the LP as long as a sufficient defibrillation threshold is obtained.

913 Stress Echo

Monday, March 25, 1996, Noon–2:00 p.m.
Orange County Convention Center, Hall E
Presentation Hour: 1:00 p.m.–2:00 p.m.

913-77 Residual Contractile Reserve in Viable Myocardium With Persistent Asynergy After Revascularization

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Preserved tracer uptake at thallium (Tl) scintigraphy and contractile reserve at low-dose dobutamine echocardiography (DE) do not guarantee functional recovery of asynergic myocardium submitted to revascularization (rev). Whether persistent asynergy after rev is associated with exhaustion of contractile reserve is unknown. We performed rest/redistribution Tl SPECT and DE (5–10 mcg/kg/min) in 21 pts (aged 62 ± 8 yrs) with prior MI (9 ant, 11 ant + inf, 1 inf) before and 5 ± 2 months after rev (17 CABG, 4 PTCA). For both T1 SPECT and DE, a 16-segments 4-points score (1 = normal; 4 = dyskinesia-severe hypoperfusion) LV model was utilized. Anterior and inferior infarct zones (IZ) were constructed. An IZ perfusion score index (PSI) and an IZ wall motion score index (WMSI) were derived. IZ were judged to be viable when: a) PSI was less than 2.9; and b) WMSI decreased of ≥ 0.22 during DE (contractile reserve).

Results: Of 30 IZ submitted to rev, 14 (47%) were judged to be viable and 16 (53%) non-viable by both pre-rev Tl SPECT and DE. Functional recovery (WMSI decrease ≥ 0.22) after rev was observed in 8/14 viable IZ (sensitivity: 89%) and 1/16 non-viable IZ (specificity: 71%). Out of the 6 IZ judged viable before rev but persistently asynergic after rev, 5 still exhibited contractile reserve at post-rev DE and all 6 showed improved thallium uptake (decrease in PSI).

Conclusion: Viable IZ, which do not recover normal resting function after rev despite improved perfusion, often exhibit contractile reserve. Myocardial viability without contractile recovery could reflect conditions of admixture of fibrosis and focal areas of viable cells, very unlikely to recover.