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VT Storm in ICD Patients



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FACULTY DISCLOSURE

Lecture Title:
VT Storm in ICD Patients

Speaker Name:
Peter P. Karpawich, MD

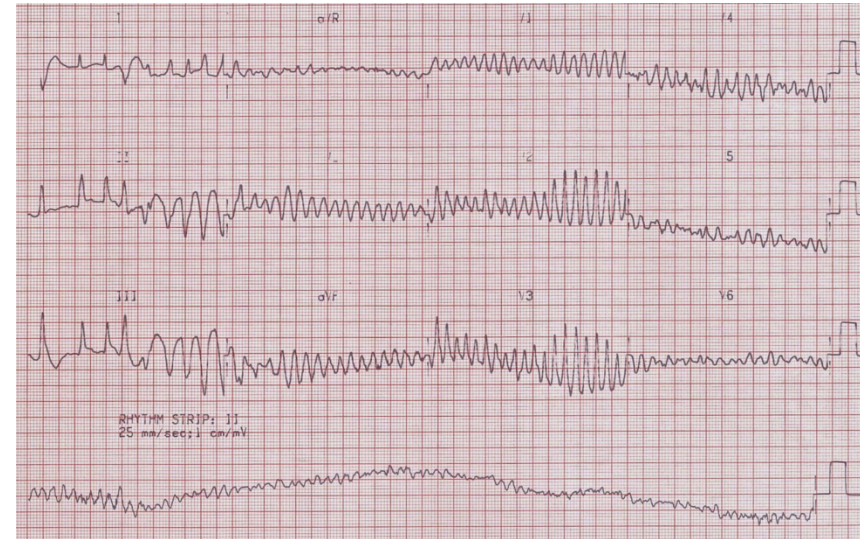
The following relationships exist related to this presentation:
NONE

Off label use of products will not be discussed in this presentation.

VT Storm in ICD Patients

Definition

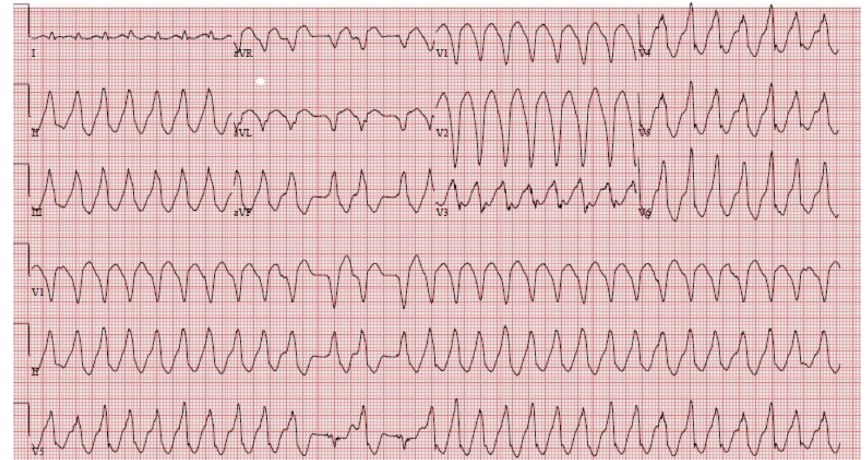
- **Recurrent electrical instability**
 - VT or VF
- **Appropriate ICD shocks**
 - > 3 in 24hrs
- **No ICD: >2 unstable events in 24hrs**
- **Incessant VT > 30 seconds**
 - Hemodynamic compromise
 - Requires intervention to terminate



VT Storm in ICD Patients

Clinical Associations

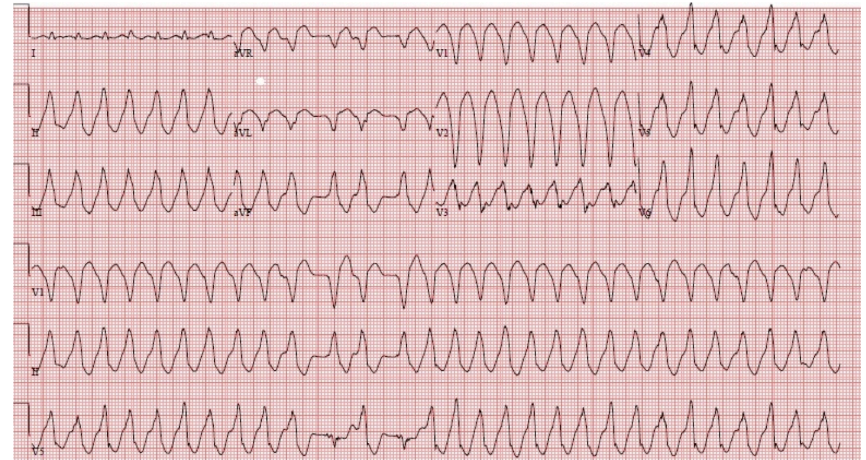
- **Coronary disease: acute MI**
- **Age (> 60y)**
- **“Structural” heart disease**
 - **TOF, ARVD, HCM**
- **Genetic Arrhythmia Conditions**
 - **Brugada, LQTc (rare)**
- **NYHA III-IV**
- **Electrolyte, thyroid imbalance**
- **Drug therapy**
 - **Tricyclic, Haloperidol, Erythromycin**



VT Storm in ICD Patients

Clinical Associations

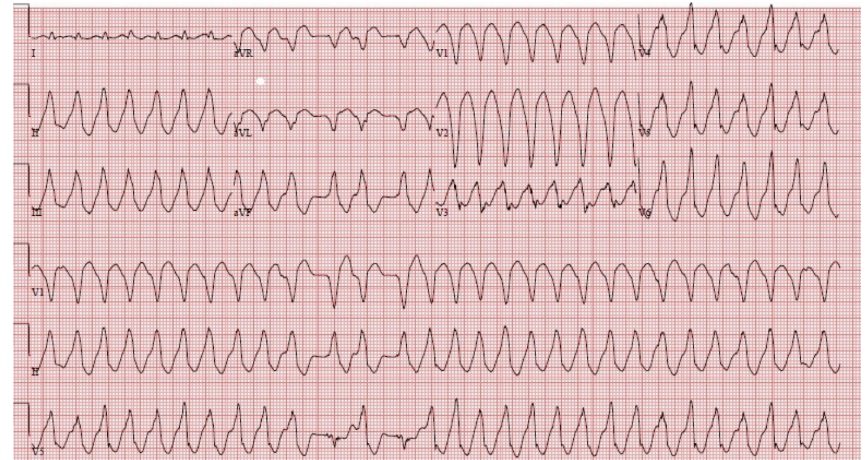
- **Digitalis**
 - Digoxin / digitoxin
 - $> 0.8\text{ng/ml}$
 - ? Worse CHF
 - ? Assoc Atrial Fib
 - ? Assoc renal disease
- **Preexisting ICD patients**
 - ~ 20%
 - Shocks = myocardial injury
 - Vent dysfunction = inc adrenergic
- **Class 1A antiarrhythmics**
 - Quinidine, Procainamide, Disopyramide depress phase 0, prolong repolarization
- **Variable mortality**
 - Death typically from underlying heart failure
 - Typically $< 3\text{mos}$ after storm



VT Storm in ICD Patients

Clinical Evaluation

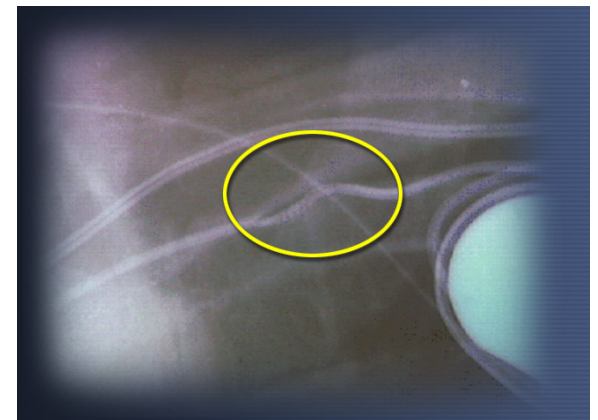
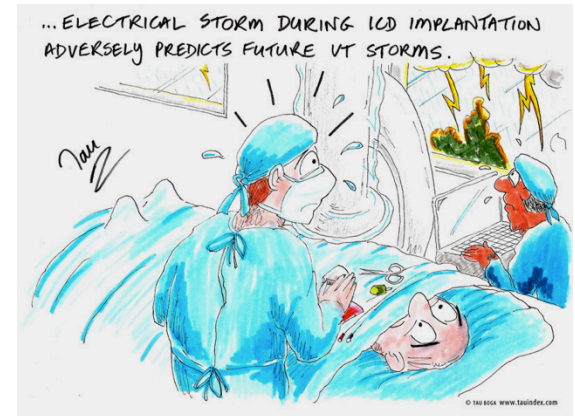
- **Confirm arrhythmia**
 - SVT with aberrancy
 - Antidromic WPW
 - Assume any wide QRS is VT
- **Both mono- and polymorphic VT**
- **Precipitating conditions**
 - **Electrolyte imbalance**
 - Hypo K⁺
 - Hypo Mg⁺⁺
 - Hypo Ca⁺⁺
 - Hyper thyroid
 - Infection, fever
 - Anxiety (inc catecholamines)



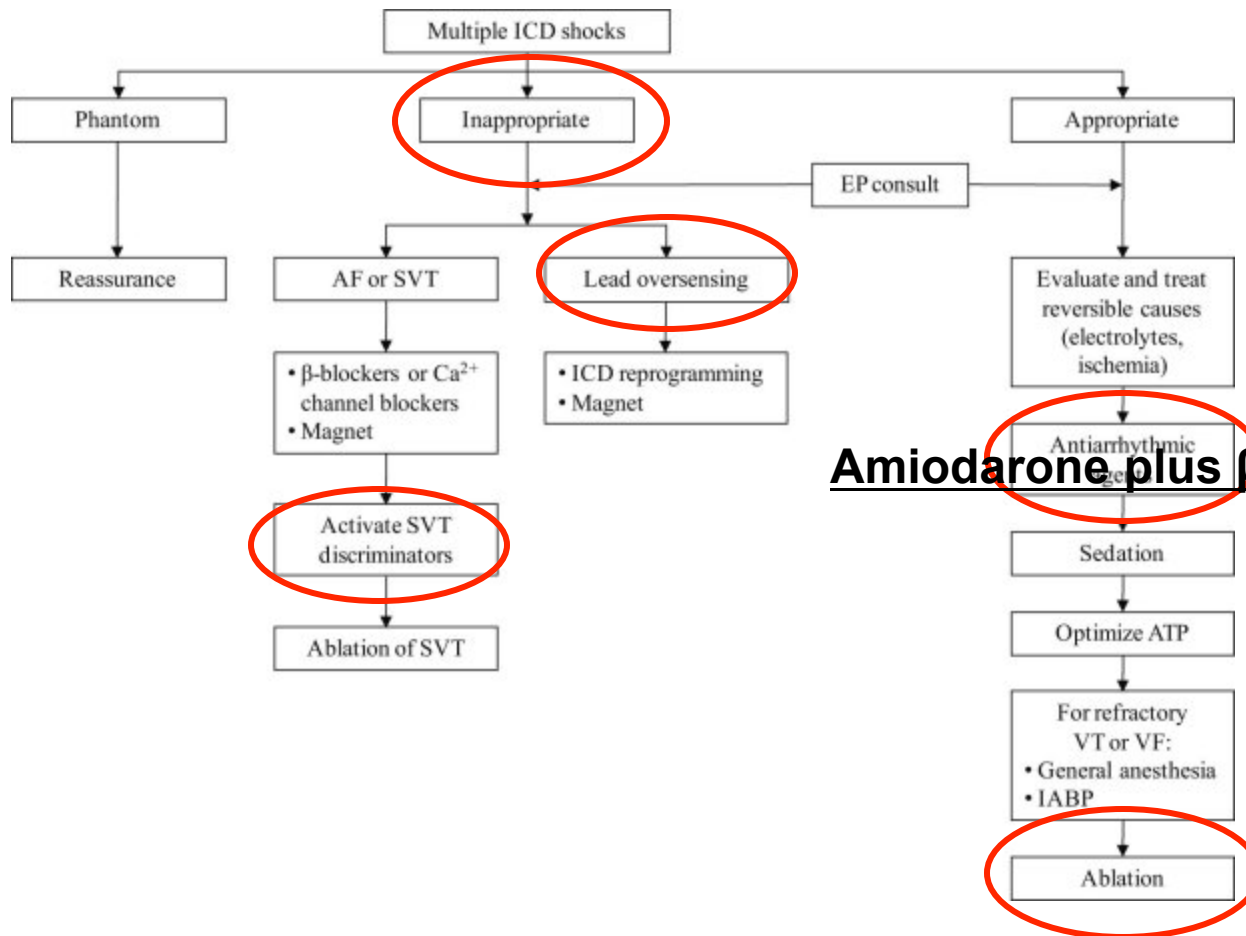
VT Storm in ICD Patients

Role of the ICD

- Implant in acute phase of storm is contraindicated
- Storm triggered by:
 - Appropriate therapy
 - Overdrive pacing
 - Cardioversion
 - Defibrillation
 - Inappropriate therapy
 - SVT
 - External sensing (EMI)
 - Lead problems



VT Storm in ICD Patients Management



Amiodarone plus β-blocker

Sensing

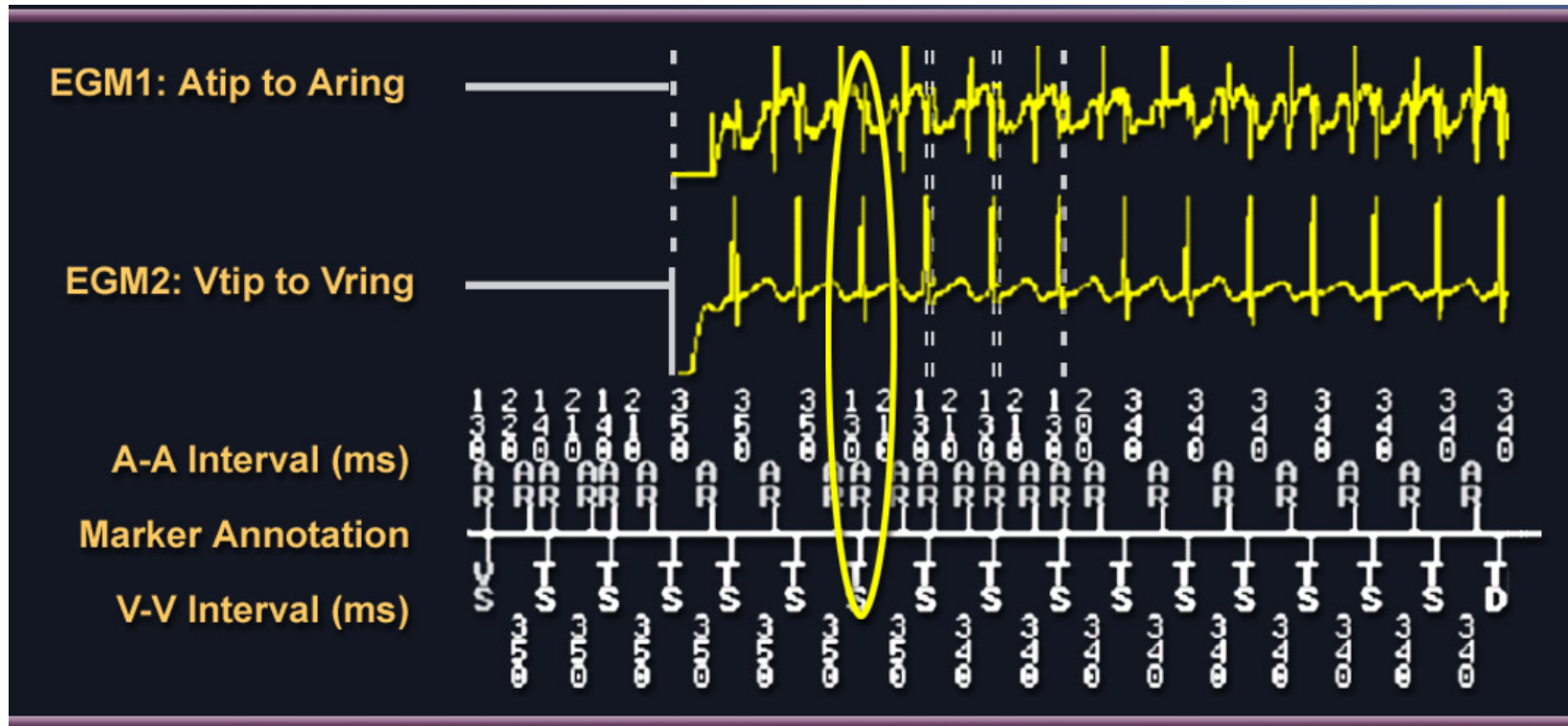
The diagram illustrates a waveform (yellow line) plotted on a green grid. A red oval highlights a specific peak in the waveform, with a red arrow pointing to it. Below the waveform, a sequence of letters (A, R, T, F, S, S, F, F, S, S, F, F, S, S, F, F, S, S, F, F, S, S) is displayed, corresponding to the waveform's state at each time step.

VT Storm in ICD Patients

Inappropriate shocks

Sensing

Far field atrial oversensing

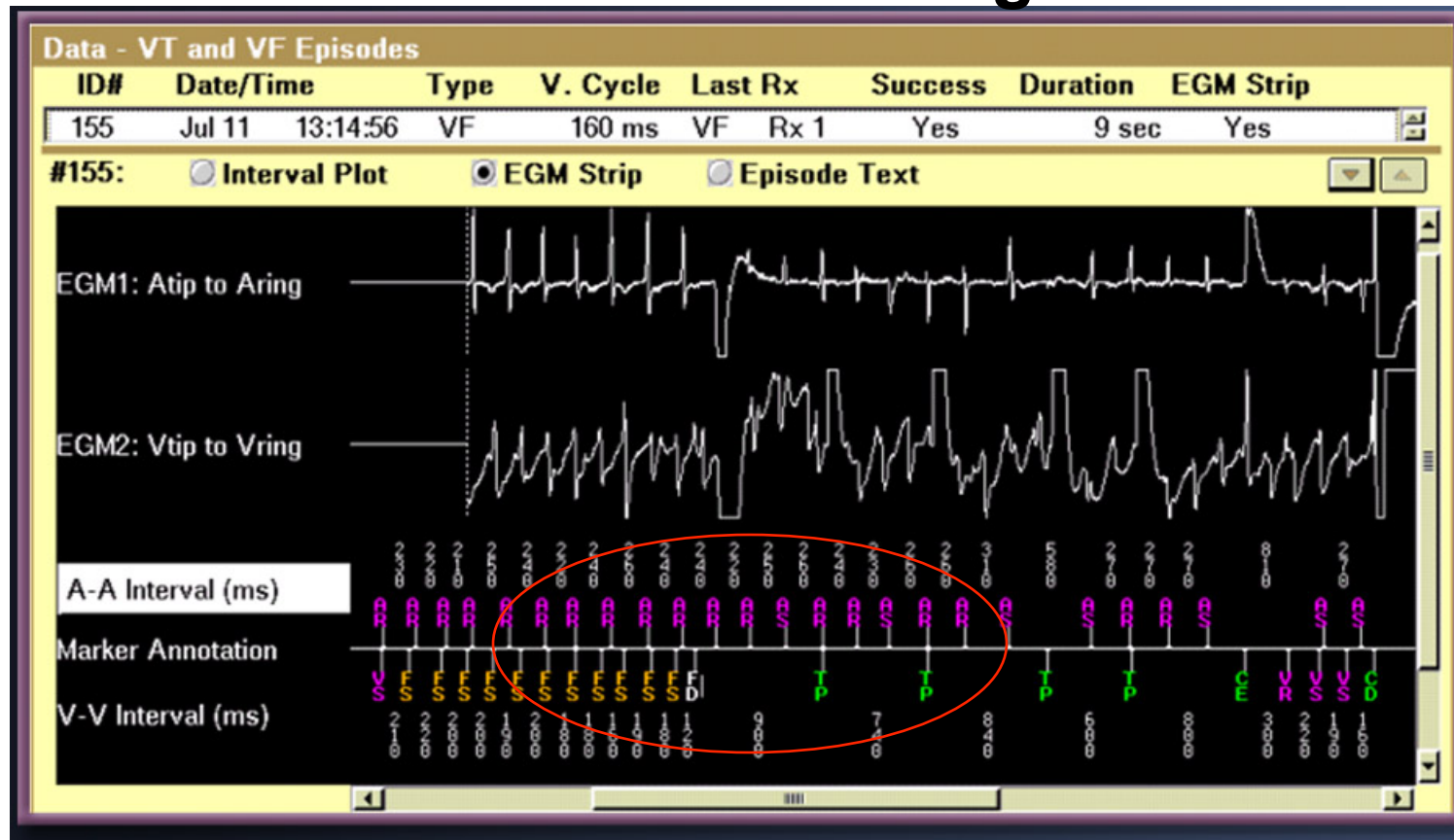


VT Storm in ICD Patients

Inappropriate shocks

Sensing

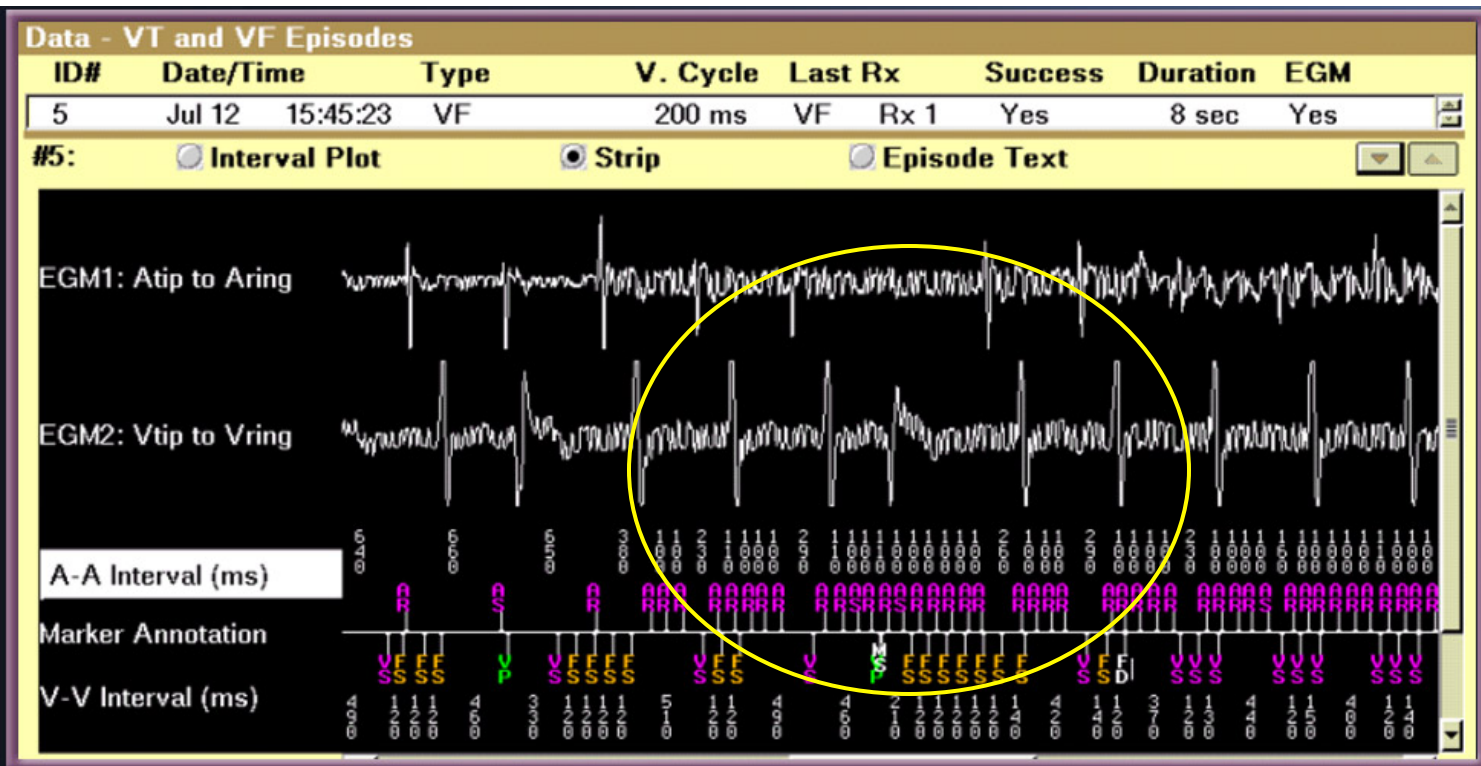
Atrial undersensing



VT Storm in ICD Patients

Inappropriate shocks

Electromagnetic interference (EMI)



VT Storm in ICD Patients

Inappropriate shocks

EMI

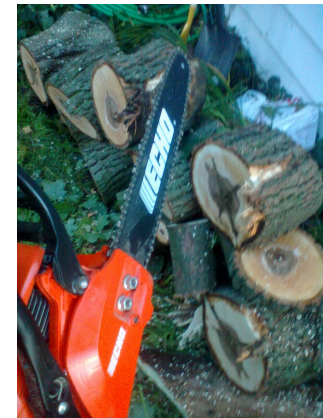
- ◆ High Intensity Electromagnetic Fields

- ◆ TV/Radio transmitting towers
 - ◆ (>100,000 volts)
- ◆ Power plants/ power lines
- ◆ Large generators

- ◆ Heavy Electrical Equipment

- ◆ Chain saw
- ◆ Arc welding equipment
- ◆ Electric steel furnaces

- ◆ Industrial Magnets

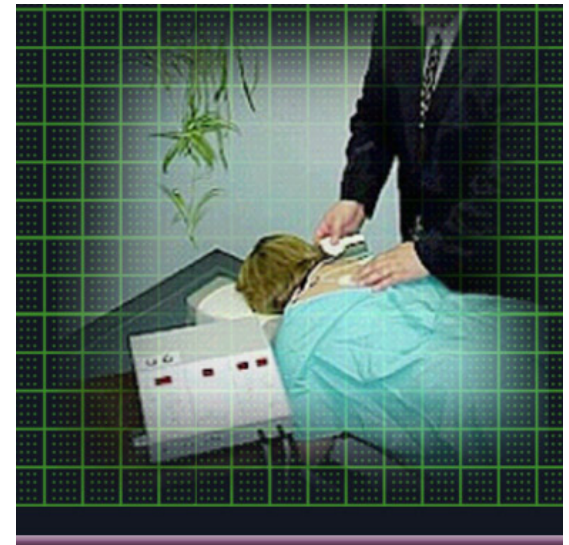


VT Storm in ICD Patients

Inappropriate shocks

EMI

- ◆ Surgical / Therapeutic equipment
 - ◆ Electrocautery
 - ◆ Transthoracic defibrillation
 - ◆ Extracorporeal shock-wave lithotripsy
 - ◆ Therapeutic radiation
 - ◆ RF Ablation
 - ◆ TENS units (nerve stimulators)
 - ◆ Heat Diathermy
 - ◆ MRI

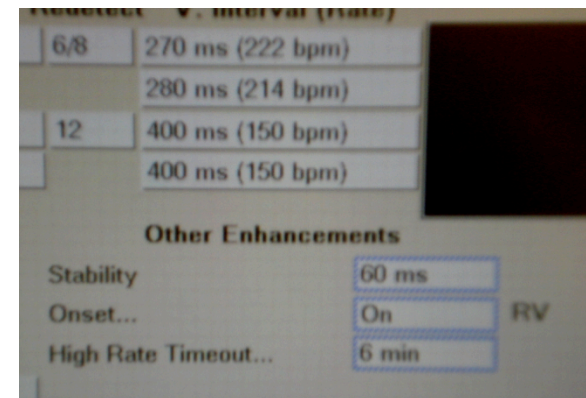


VT Storm in ICD Patients

Inappropriate shocks

Rhythm Discriminators

- **Stability**
 - Differentiate AFib vs VT
 - Continuous assessment
- **Onset**
 - Gradual (Sinus) vs Abrupt (VT)
- **QRS Morphology**
 - SVT vs VT
 - Not effective if preexisting BBB
- **Sustained rate detection**
 - Prevent VT under detection
 - Limit withholding therapy delivery



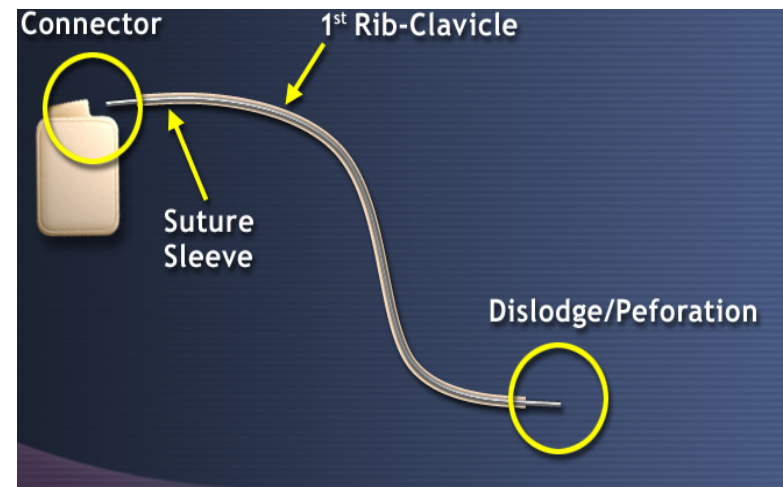
Rate Branch	Additional Discriminators			Diagnosis	
AF/A Flutter V < A	Morphology		Interval Stability	If Any of the criteria in this rate branch indicate VT, deliver therapy.	
	Morphology	On	Interval Stability		On
	Match	60 %, 5 of 8	Stability Delta		80 ms
	AutoUpdate	Off	AV Association Delta		60 ms
			(passive)		
			Window Size	12 intervals	
Sinus Tach V = A: On	Morphology		Sudden Onset	If Any of the criteria in this rate branch indicate VT, deliver therapy.	
	Morphology	On	Sudden Onset		On
	Match	60 %, 5 of 8	Onset Delta		18 %
	AutoUpdate	Off			
AV Interval Delta: Off					
VT/VF				If Ventricular Rate is greater than the Atrial Rate, deliver therapy.	
V > A					

VT Storm in ICD Patients

Inappropriate shocks

Lead Issues

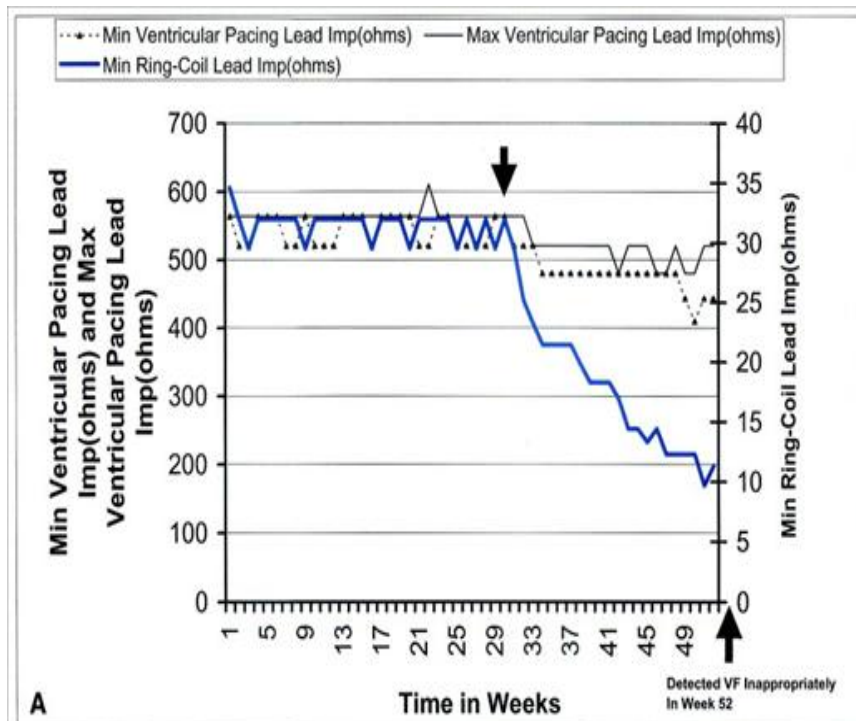
- ◆ Impedances
 - ◆ ICD leads more complicated and less efficient than pacing leads
 - ◆ 5y lead survival 85%
 - ◆ Recent recalls
- ◆ High points of stress and pressure on lead
- ◆ Fractures, insulation tears



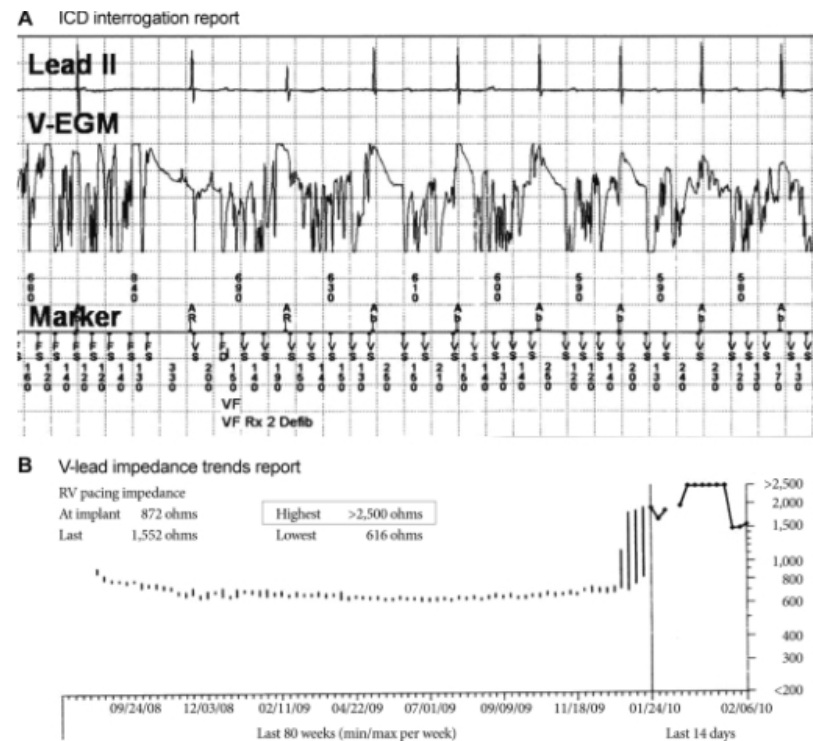
VT Storm in ICD Patients

Inappropriate shocks

Lead Issues - Impedances



Impedance drop



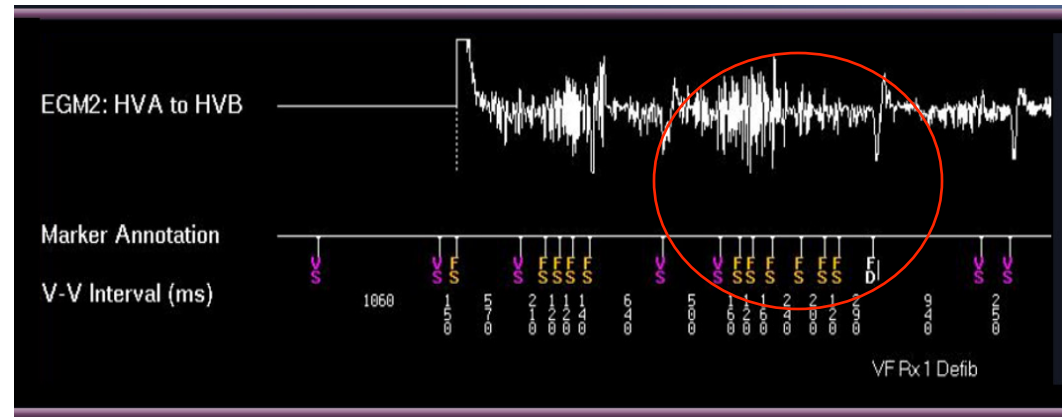
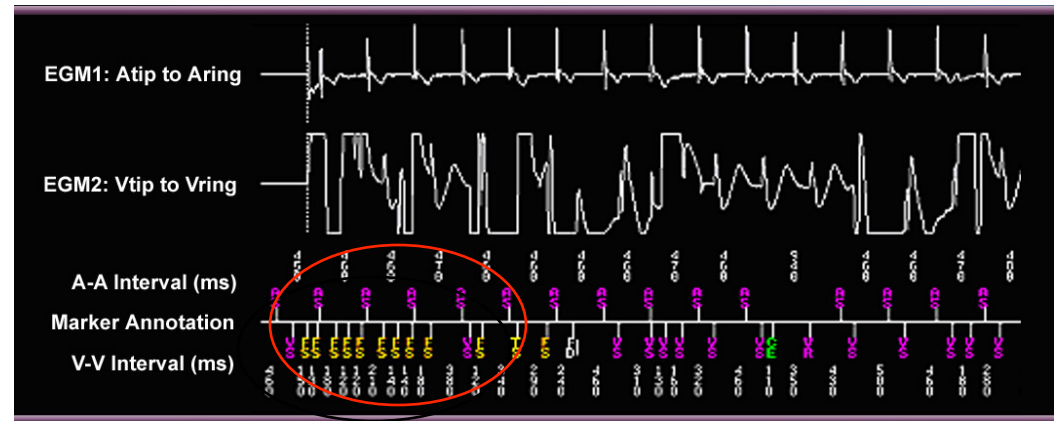
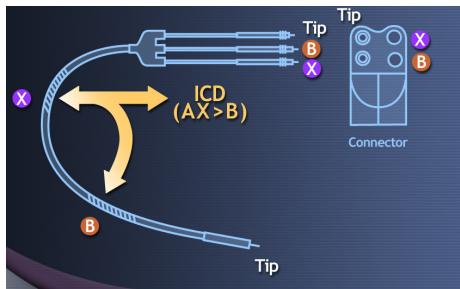
Impedance rise

VT Storm in ICD Patients

Inappropriate shocks

Lead Issues

- ◆ Fracture
- ◆ Erratic sensing
- ◆ Intermittent or loss of capture
- ◆ High lead impedance

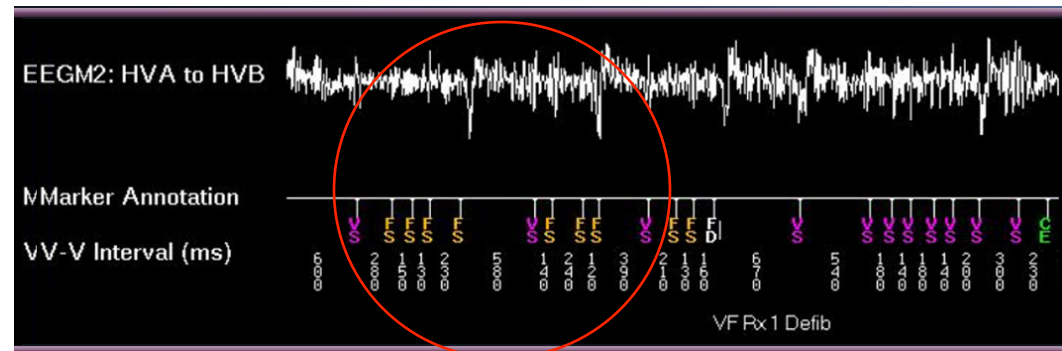
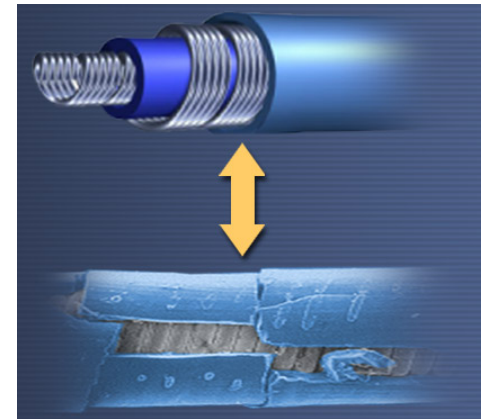


VT Storm in ICD Patients

Inappropriate shocks

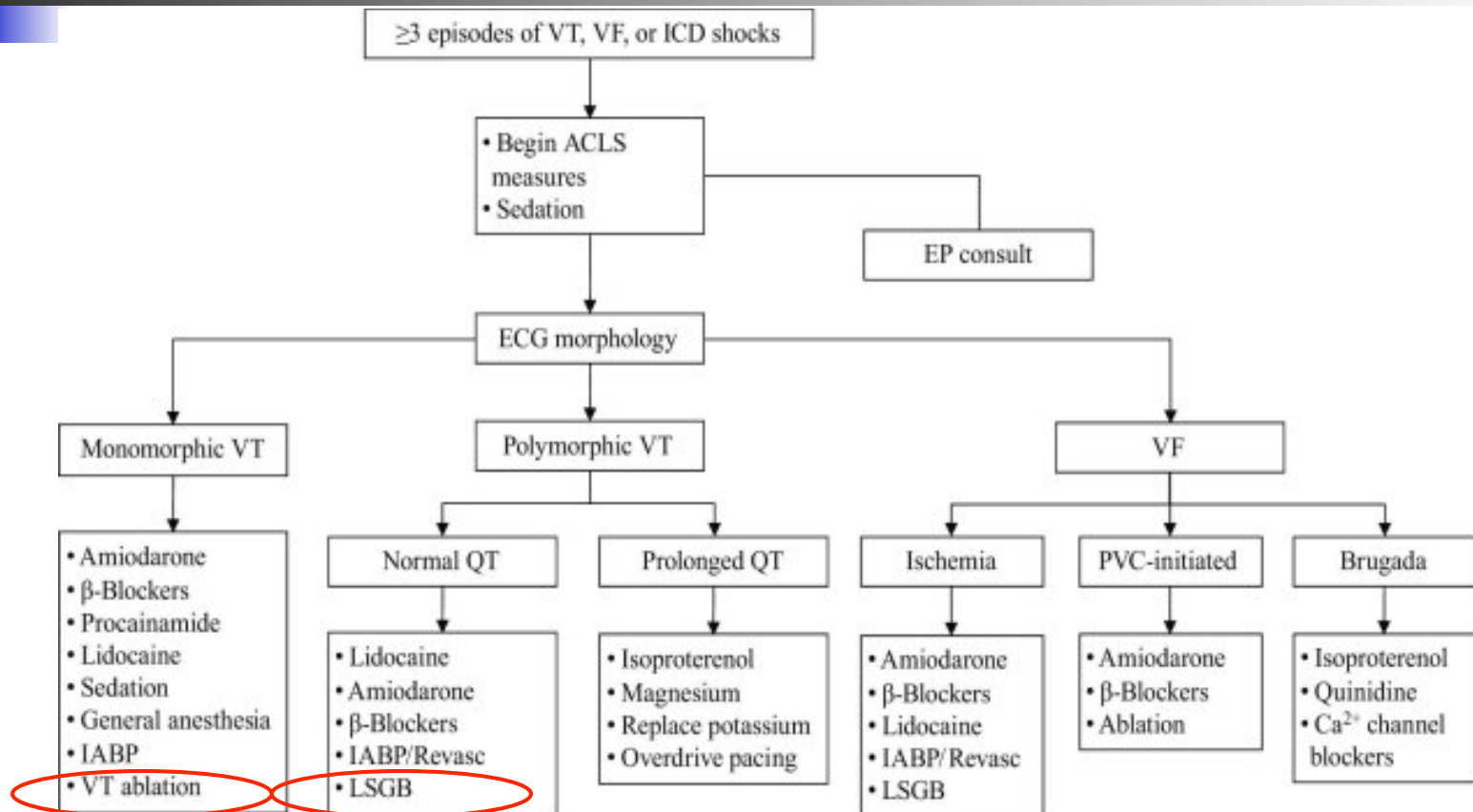
Lead Issues

- ◆ Insulation tear
 - ◆ Low impedance
 - ◆ Consistent or intermittent
 - ◆ Sudden change in capture threshold
- ◆ Over / undersensing
- ◆ Major concern today
 - ◆ ICD lead recalls



Electronic Noise

VT Storm in ICD Patients Management

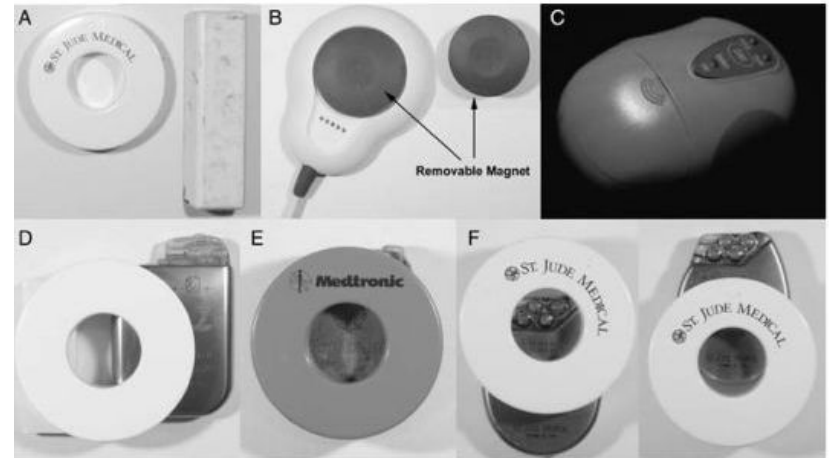


VT Storm in ICD Patients

Management

■ Magnet

- If SVT, magnet will inhibit sensing
- If VT, remove magnet will enable therapy delivery
- ICD pacing not affected by magnet

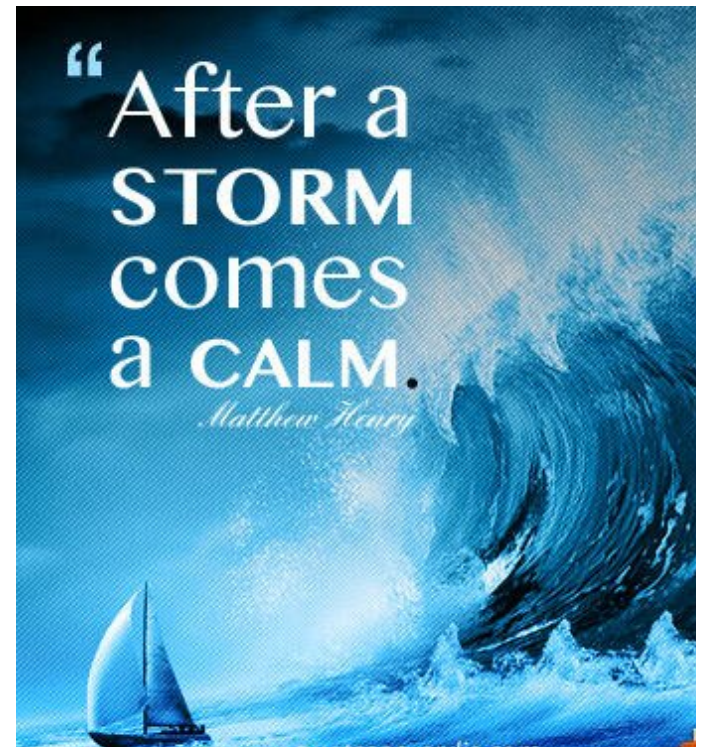


VT Storm in ICD Patients

Inappropriate shocks

Conclusions

- Is relatively common among ICD recipients
- Associated with a poor clinical outcome
- Etiologies are multiple and variable
- Need to carefully identify reversible etiologies and make corrections
- Apply effective preventive management



THANK YOU



Whenever I use my iphone, I get a shock from my ICD