

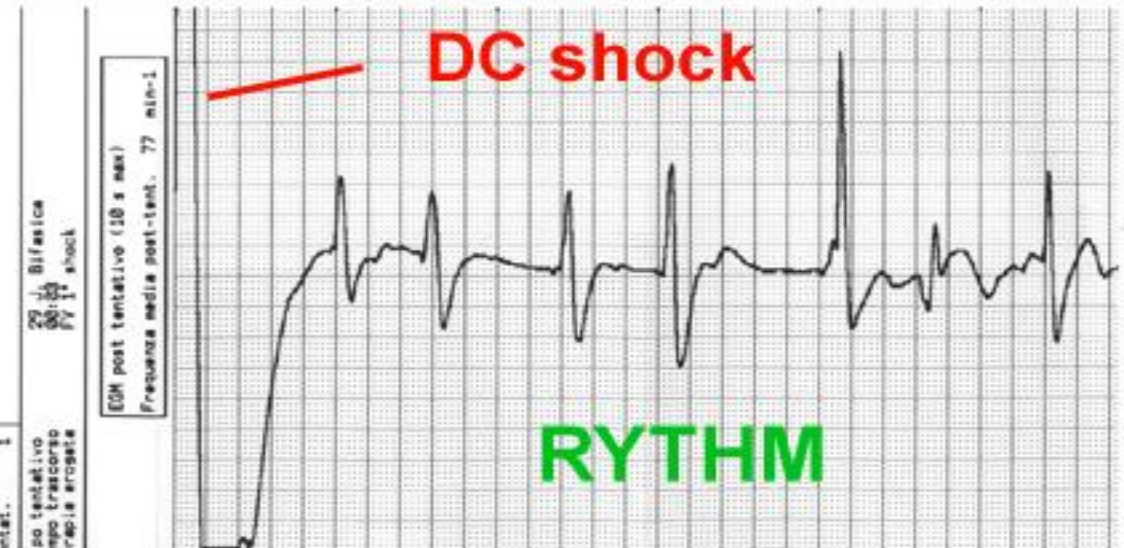
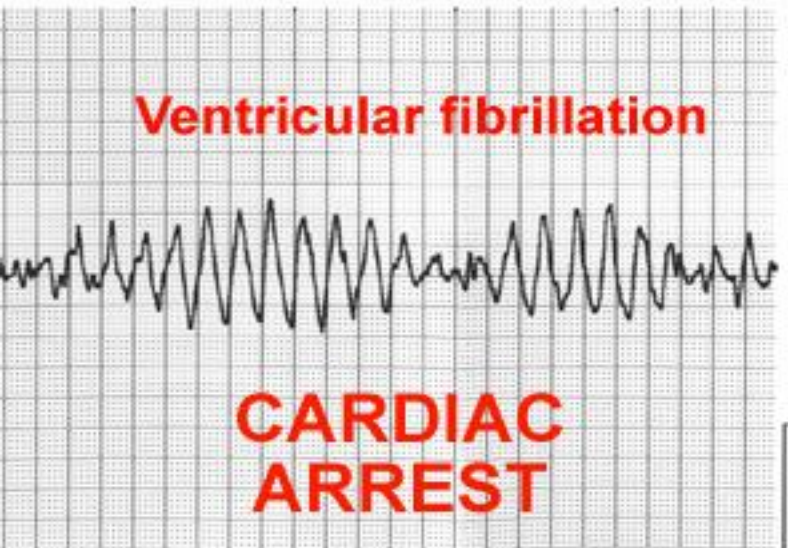
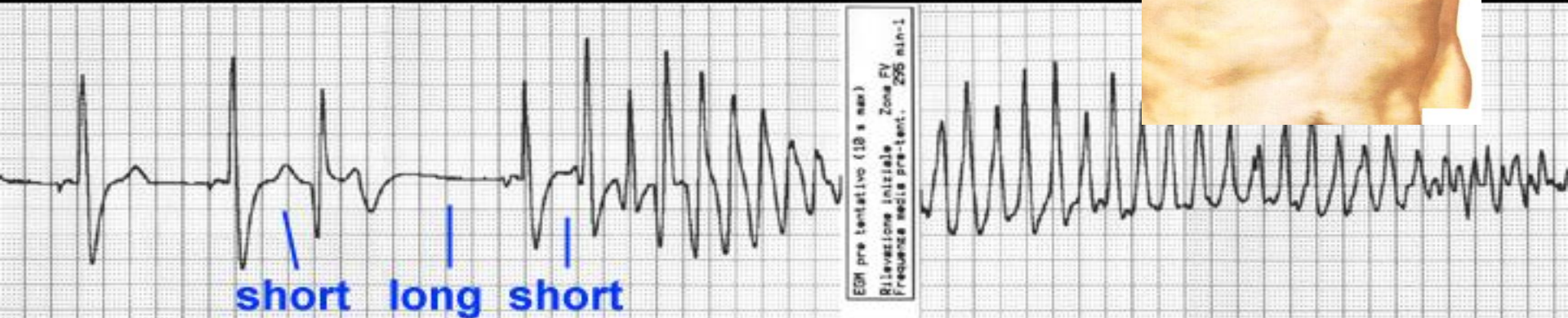
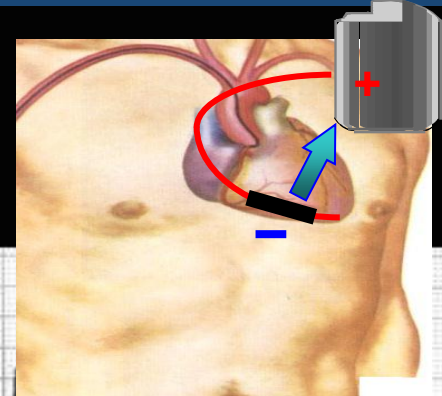
Troubleshooting the firing ICD: a practical approach in the emergency room



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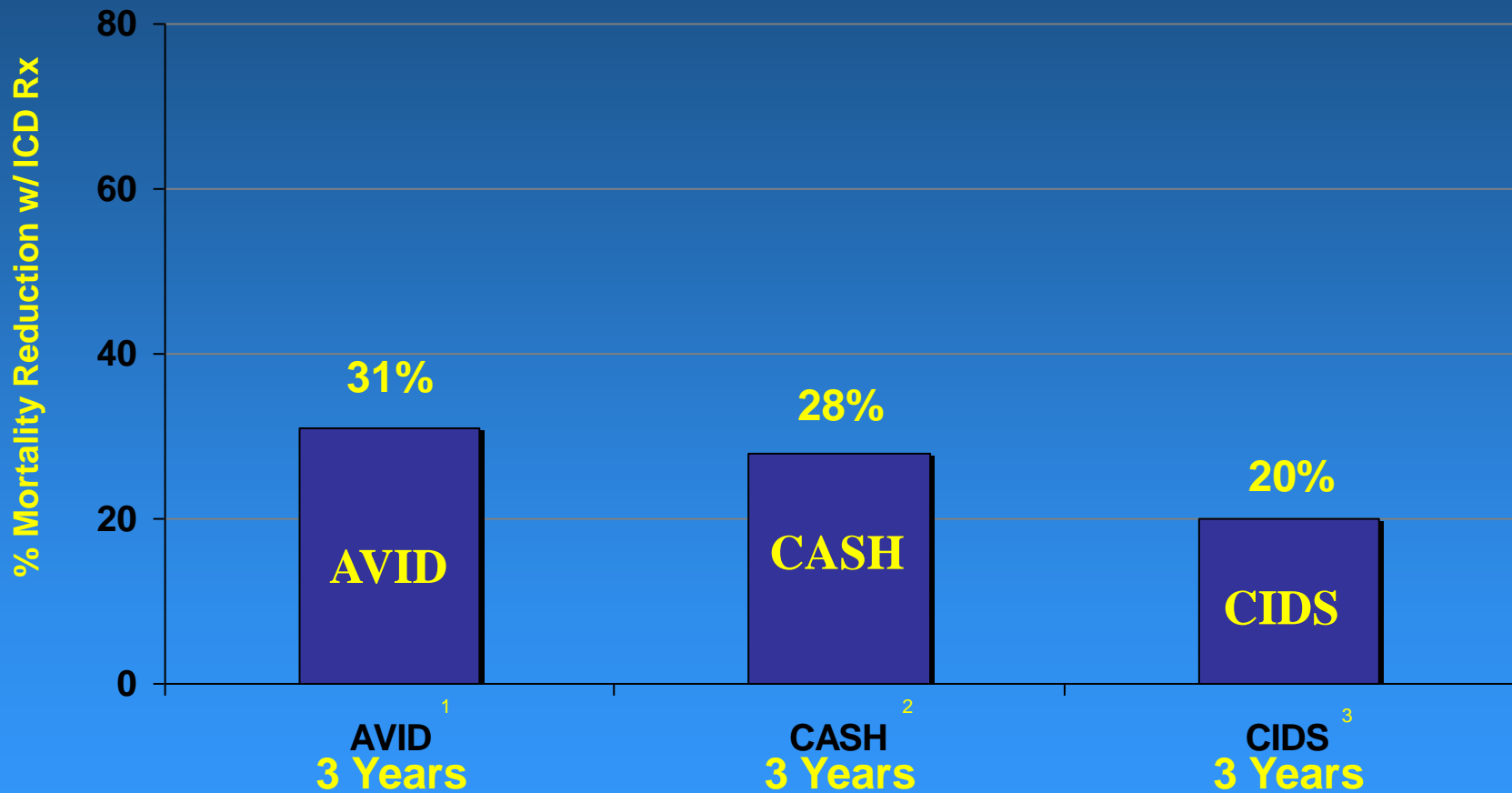
ICD: Mortality reduction in heart failure patients



EGM storage

Secondary Prevention Trials

Reduction in Overall Mortality with ICD Therapy

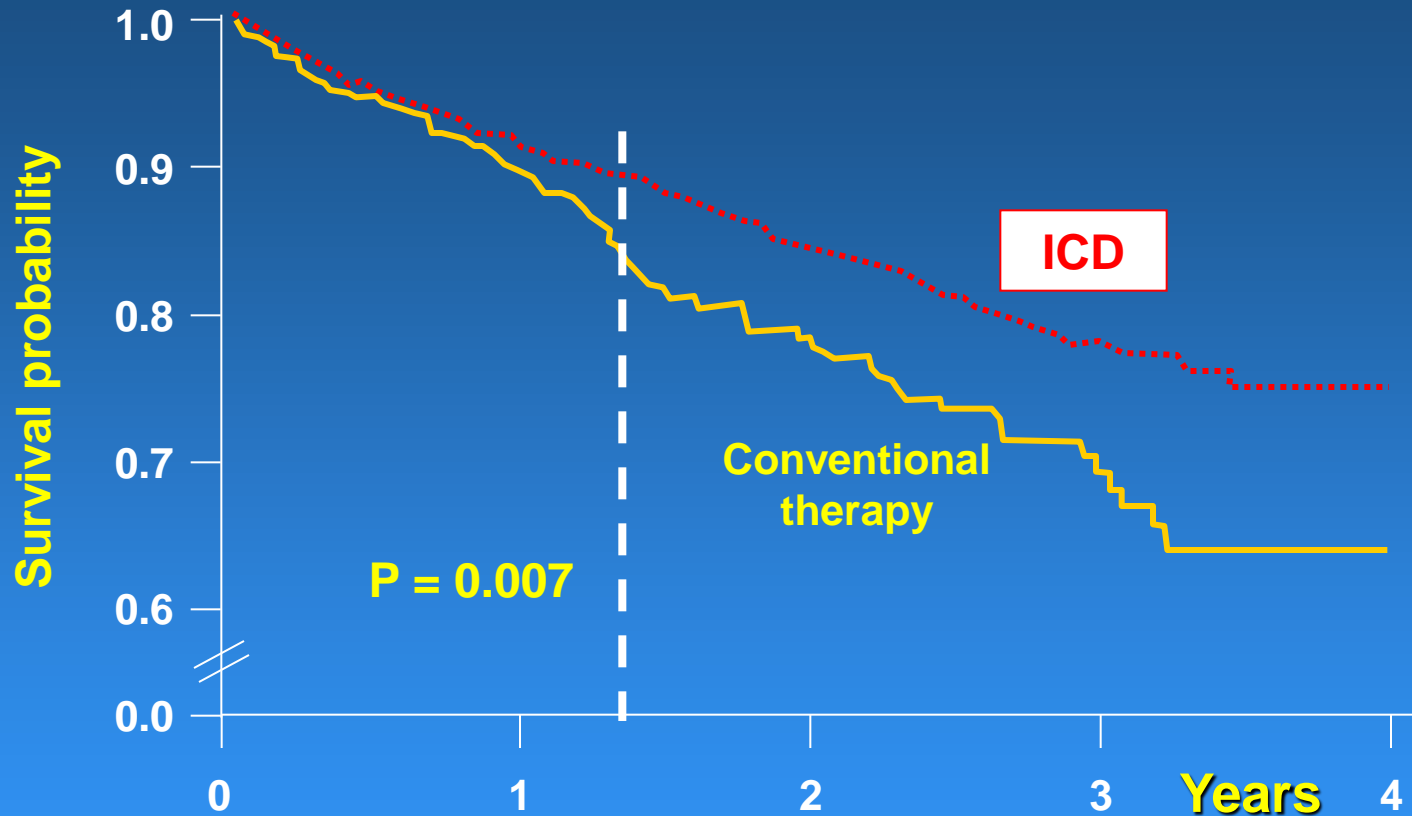


¹ The AVID Investigators. *N Engl J Med.* 1997;337:1576-83.

² Kuck K. *Circ.* 2000;102:748-54.

³ Connolly S. *Circ.* 2000;101:1297-1302.

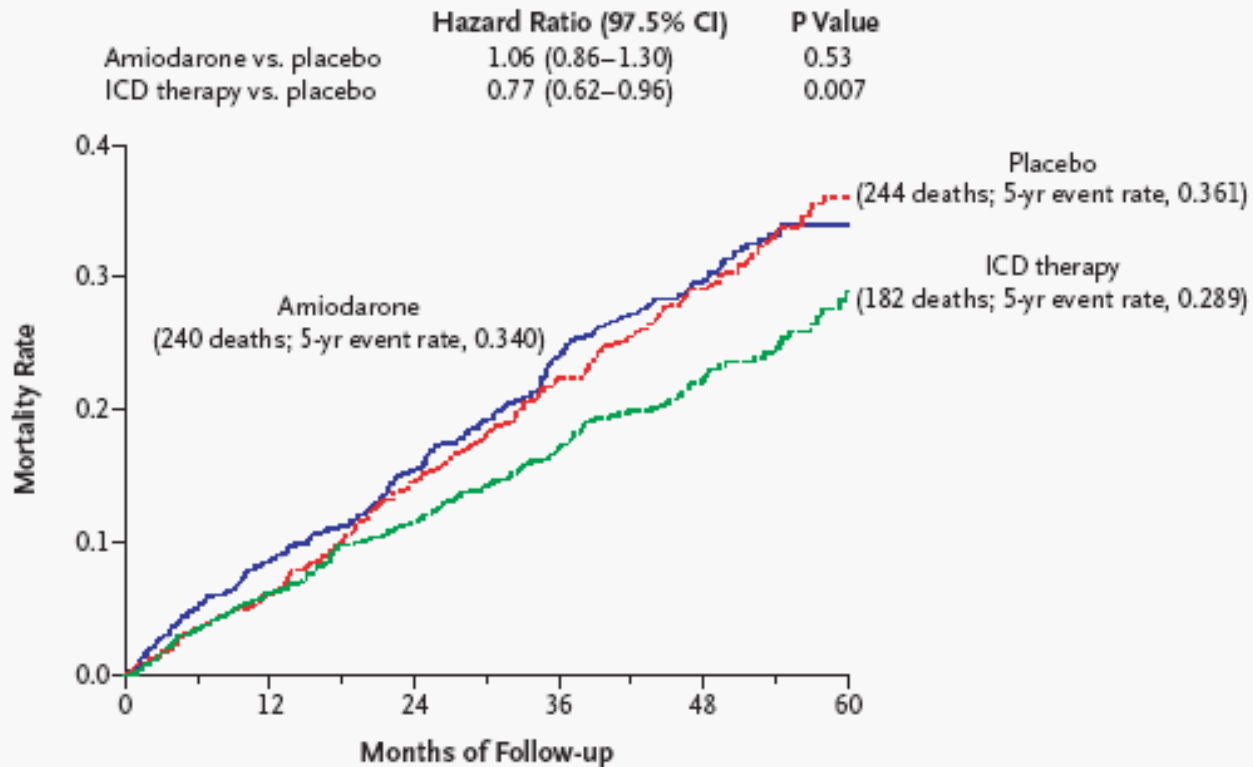
Primary Prevention - MADIT II



Risk Pts number

ICD	742	502 (0.91)	274 (0.94)	110 (0.78)	9
Conventional	490	329 (0.90)	170 (0.78)	65 (0.69)	3

Primary prevention - SCD-HeFT



No. at Risk

Amiodarone	845	772	715	484	280	97
Placebo	847	797	724	505	304	89
ICD therapy	829	778	733	501	304	103

Are complications of implantable defibrillators under-estimated and benefits over-estimated?

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Received 19 April 2009; accepted after revision 6 June 2009; online publish-ahead-of-print 4 July 2009

ICD PROBLEMS

Electrical storm

Inappropriate ICD shock

ICD system malfunctions

**Mechanical Problems (infections,
decubitus, pain, ...)**

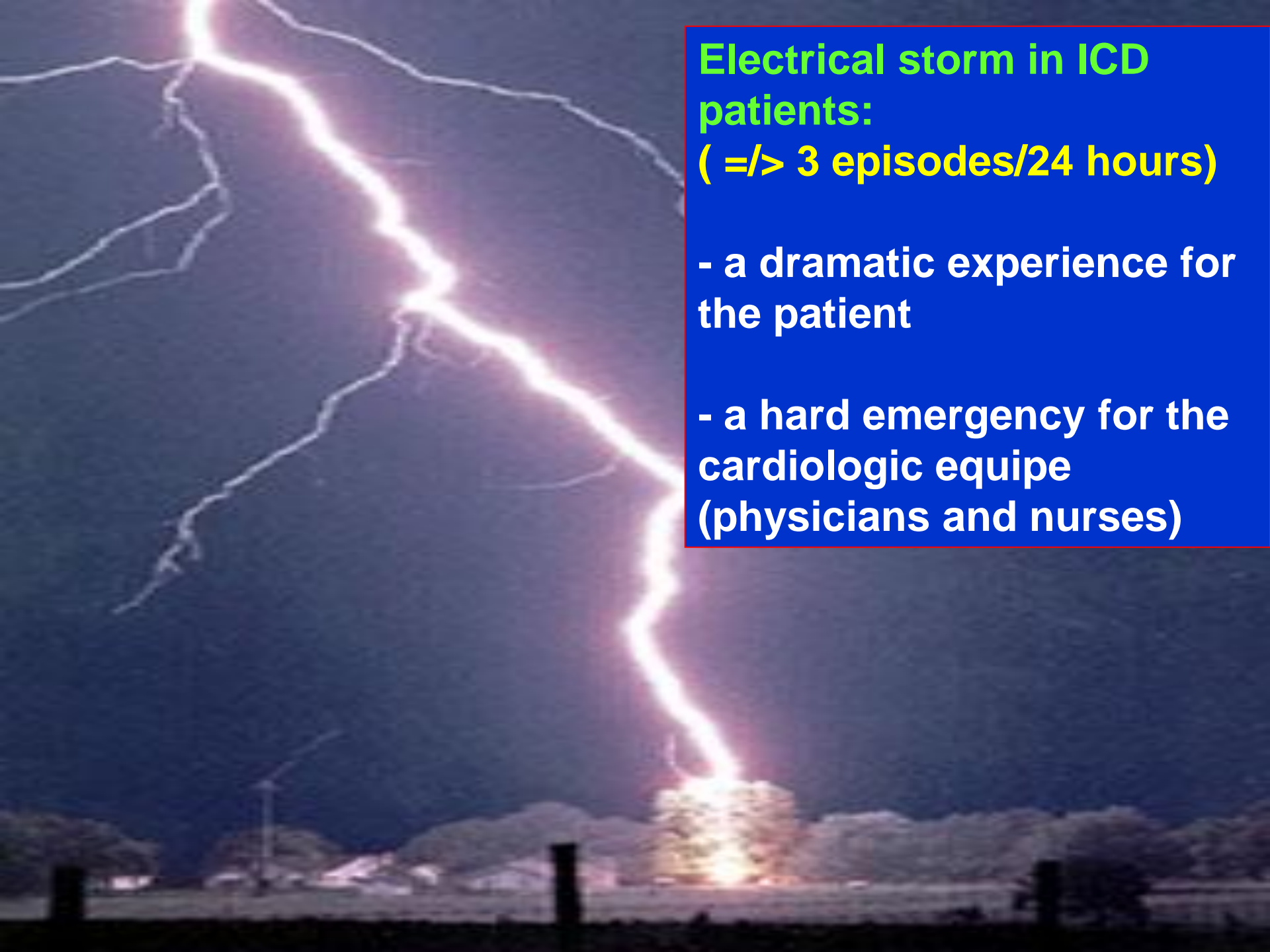
**Psychological problems (themselves,
shock related,)**

ICDs Troubleshooting

Electrical storm

Inappropriate ICD shocks

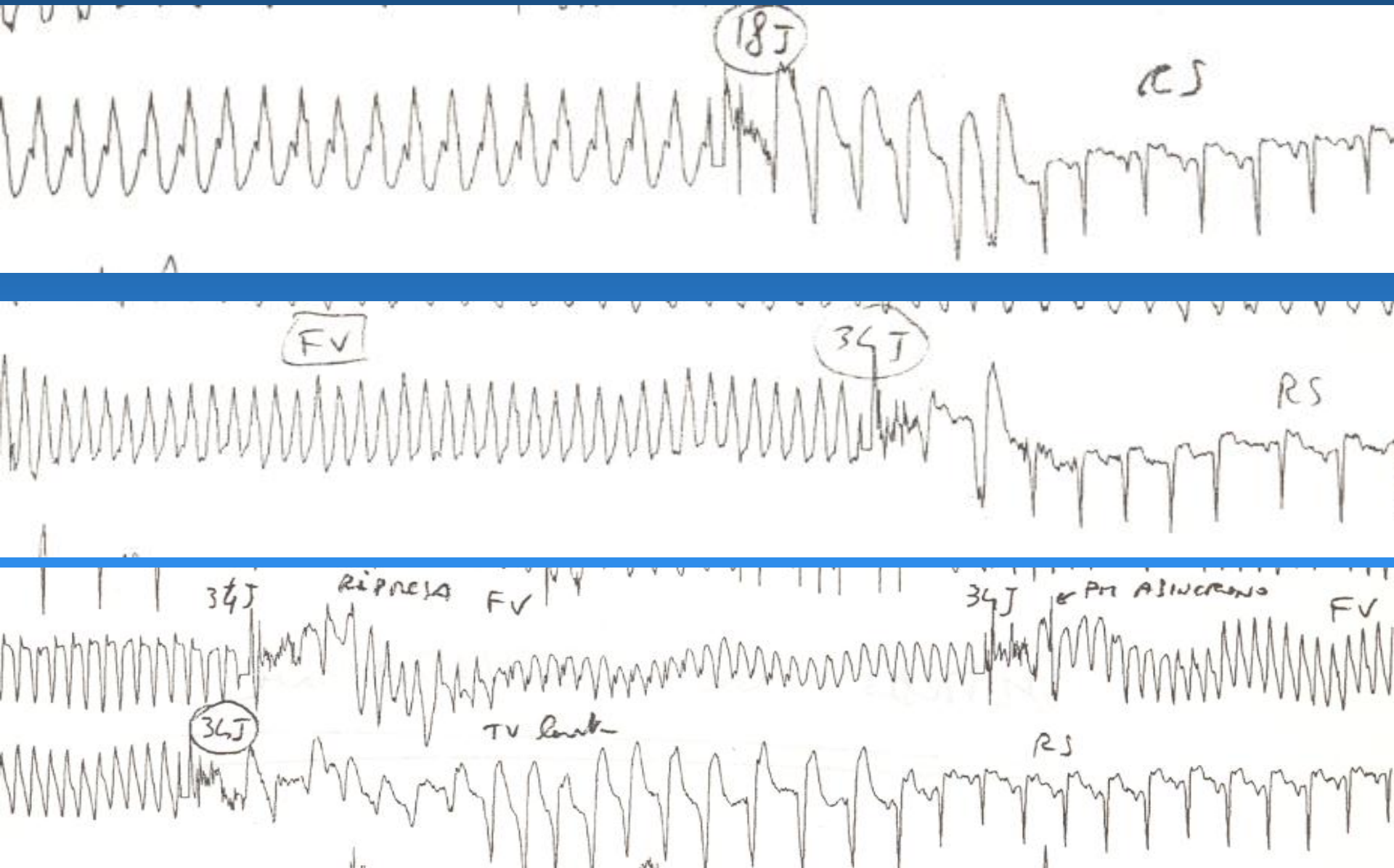
ICD system malfunctions



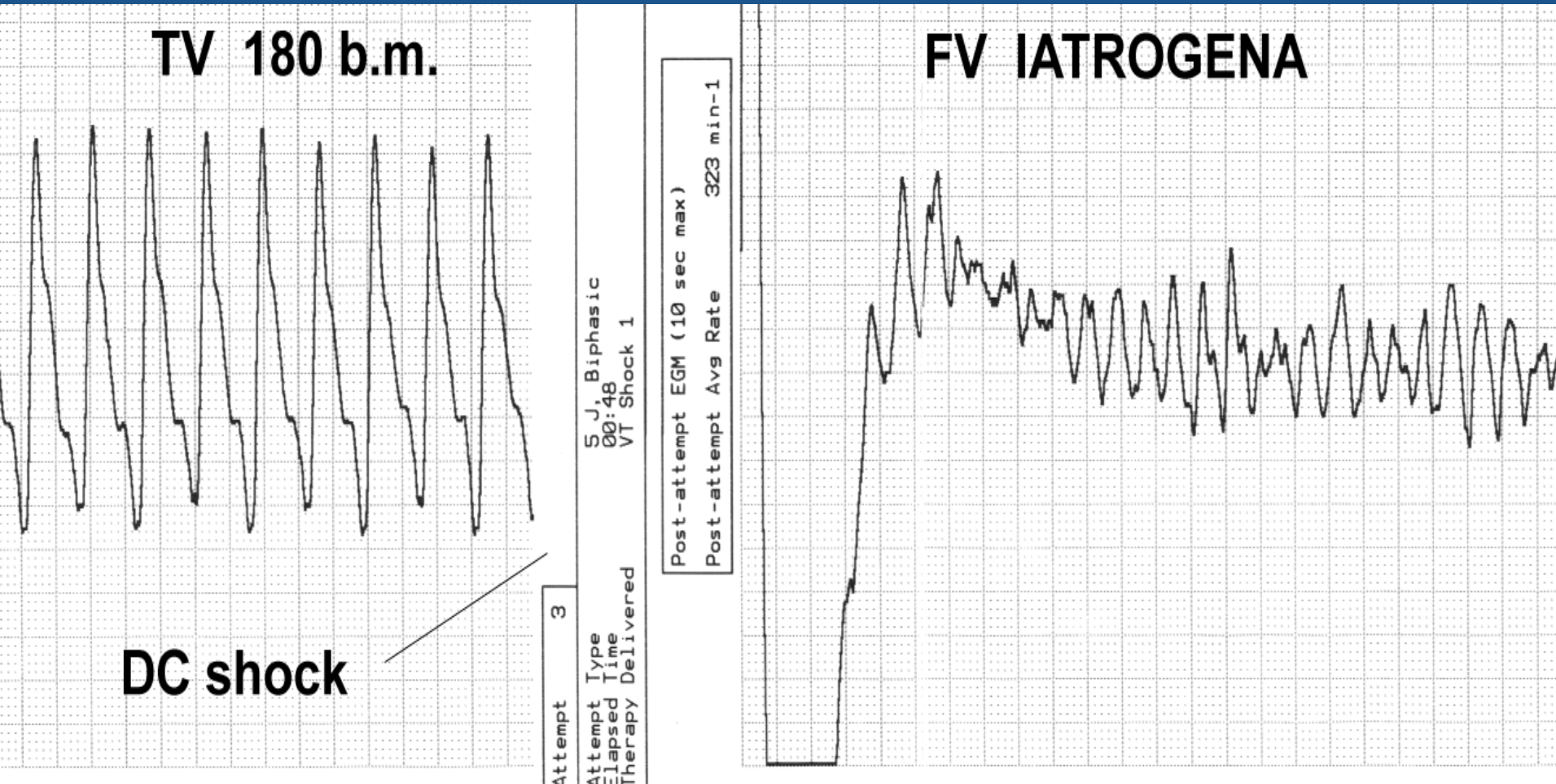
**Electrical storm in ICD patients:
(\geq 3 episodes/24 hours)**

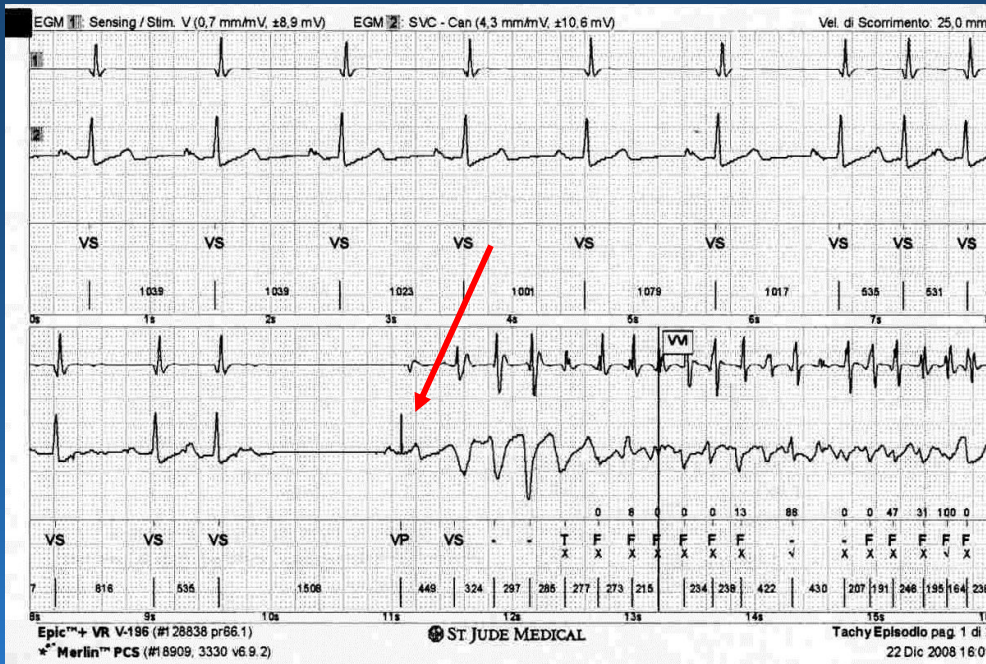
- a dramatic experience for the patient
- a hard emergency for the cardiologic equipe (physicians and nurses)

ELECTRICAL STORM in ICD patients (≥ 3 episodes/24 hours)



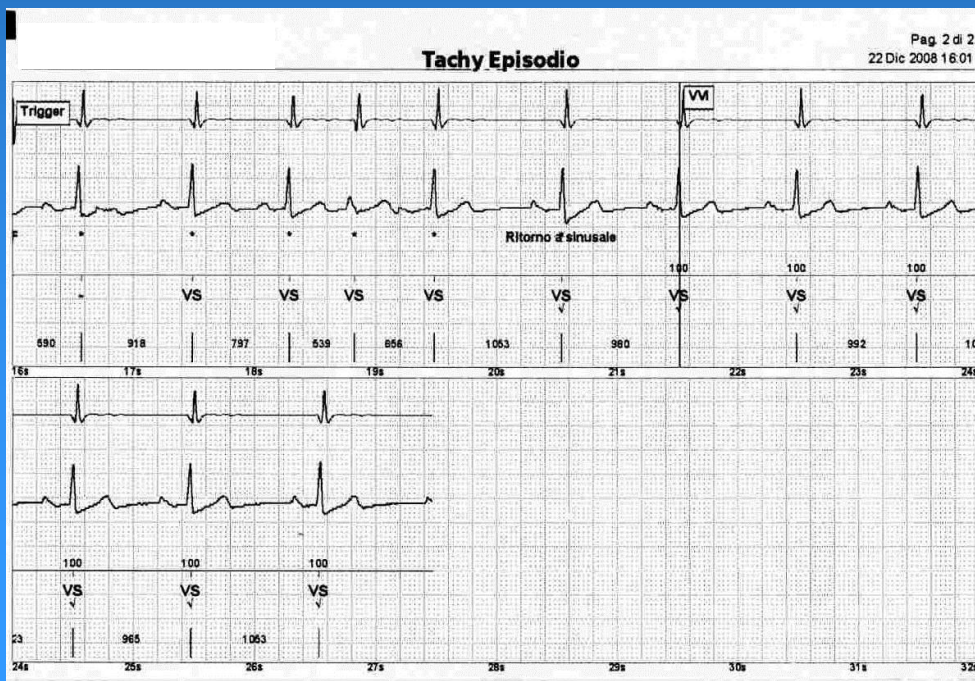
Iatrogenic ICD tachyarrhythmias worsening





Ventricular tachyarrhythmias ICD “induced”

Some Premature Ventricular Complexes produce the short-long cycle phenomenon. After a long cycle (postPVC compensatory cycle) a ventricular pacing within the relative refractory period induce a iatrogenic polymorphic ventricular tachyarrhythmias (secondary ICD unnecessary shock)



Electrical storm in ICD patients

Licterature

Incidence: 10-20% of ICD patients

Occurrence: 24 hours after implant
during normal follow up
pre-dead phase

Mean of episodes number: 8
range: 3 - 50

% of hospitalization: 85%

Population- Arrhythmologic Center - Novara

	Group A No ICD therapy		Group B Isolated ICD therapy		Group C Electrical Storm	
N. pts	33% 83		54% 135		13% 32	
Years	64+/-12		64+/-10		65+/-8	
Sex						
Men	72 (87%)		118 (87%)		26 (81%)	
Women	11 (13%)		17 (13%)		6 (19%)	
EF (%)	37+/-12	p=0.01 (C)	31+/-10		31+/-10	
Cardiopathy						
Ischemic	57 (69%)			97 (72%)		24 (75%)
Dilatative	12 (14%)			26 (19%)		4 (12,5%)
Others	13 (16%)			11 (8%)		4 (12,5%)
None	1 (1%)		1 (0,7%)		0 (0%)	
Primary pr.	47 (57%)		34 (25%)		7 (22%)	
Secondary pr.	36 (43%)		101 (75%)		25 (78%)	

Population- Arrhythmologic Center - Novara

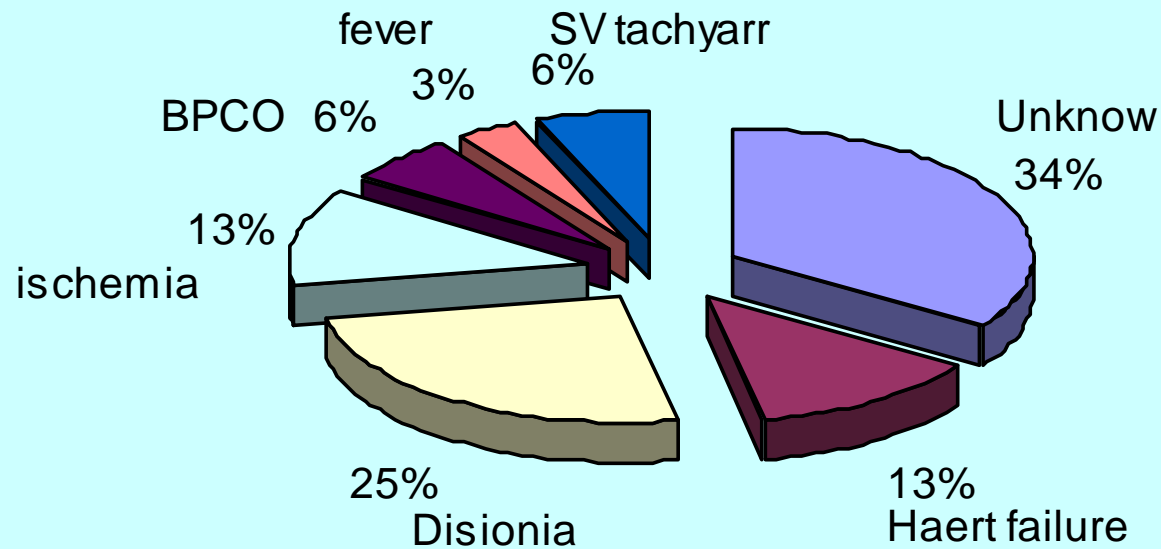
32 patients with Electrical Storm

- 50 episodes of storm (1,5/patient)
- First storm: 42+/-37 months from implant
- 14 patients (43%) had 2 episodes
- 3 patients had 3 episodes
- 1 patient had 4 episodes

Population- Arrhythmologic Center - Novara

50 episodes of storm (32 pts)

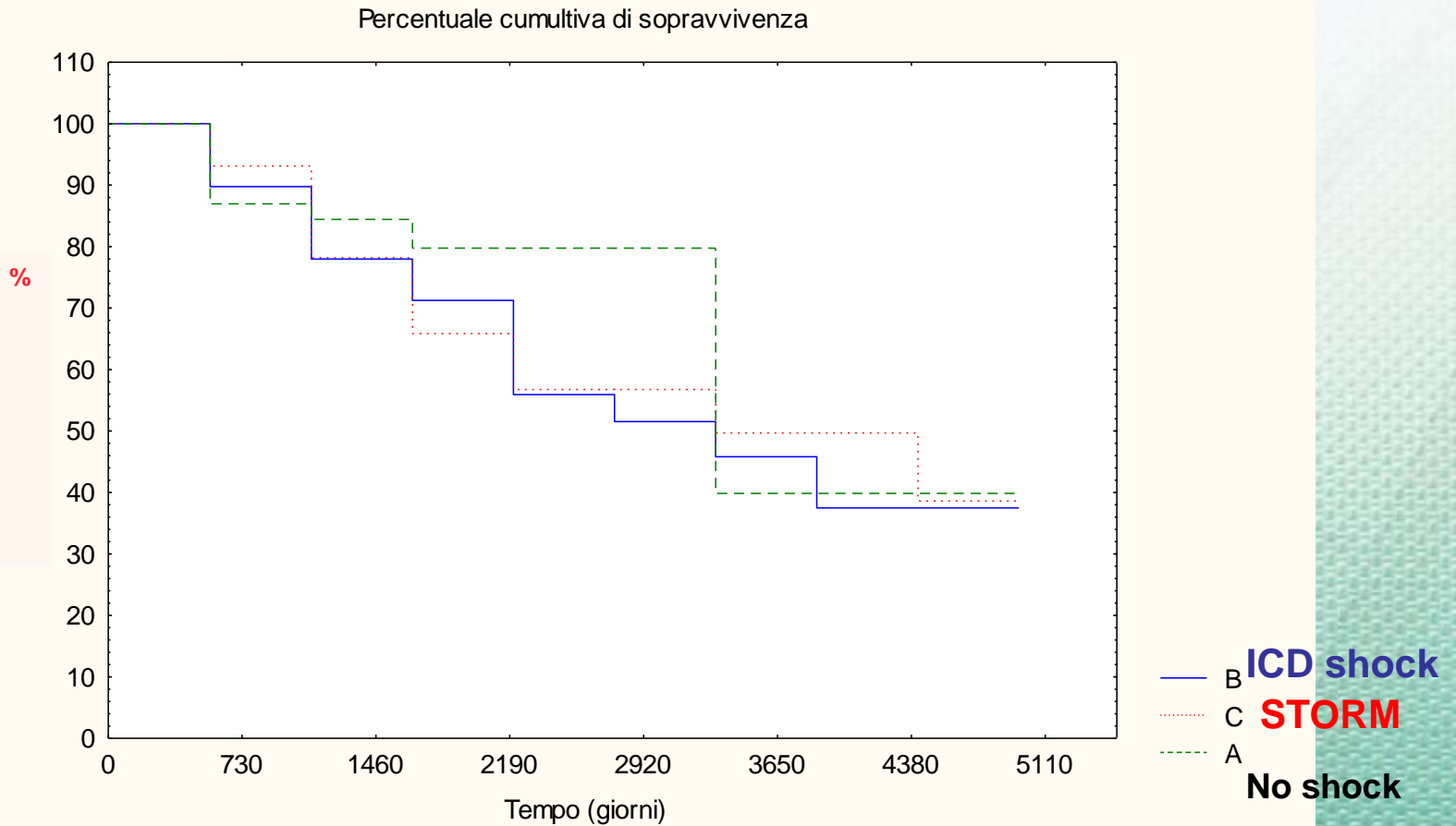
Triggering factors



RESULTS – END POINT

Cardiac MORTALITY and/or Cardiac Transplantation

Cumulation Survival Curve



Inappropriate ICD shocks

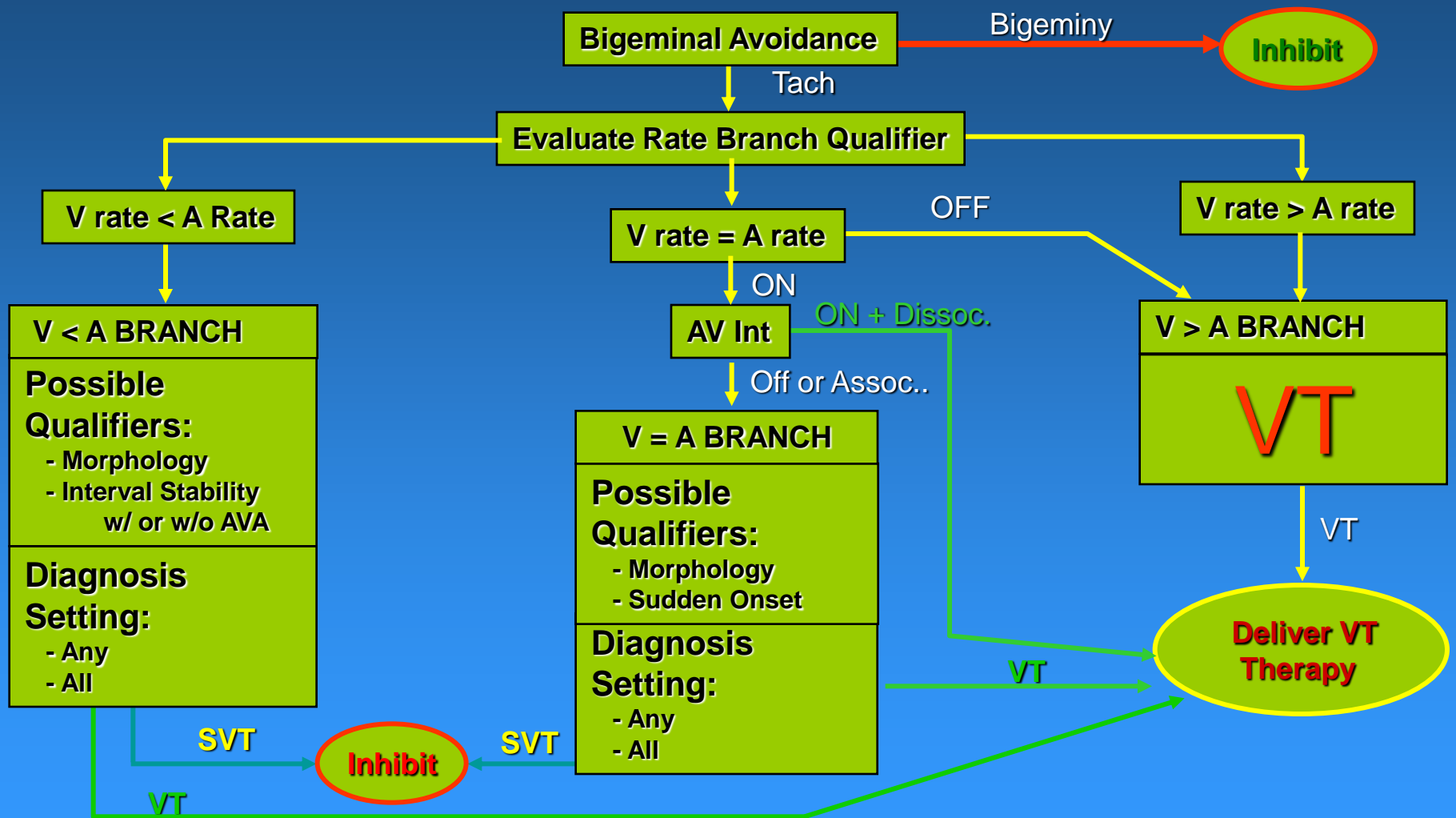
Inappropriate VT detection due to SUPRAVENTRICULAR tachyarrhythmias:

- Atrial Fibrillation, Atrial Flutter, Atrial ectopic tachycardia, SVPT)
- Sinus Tachycardia > TV detection cut-off

Complex Algorithms to reduce inappropriate shocks due to Supraventricular tachyarrhythmias

**Sudden Onset
Stability
QRS Width
QRS Morphology
Atrial Sensing**

Very complex ICD AV algorithm to VT/SVT discrimination



Inappropriate implantable cardioverter-defibrillator discharges unrelated to supraventricular tachyarrhythmias

Eraldo Occhetta*, Miriam Bortnik, Andrea Magnani, Gabriella Francalacci, and Paolo Marino

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Received 6 February 2006; accepted after revision 11 May 2006; online publish-ahead-of-print 17 August 2006

Table 1 Patients/ICD system characteristics and causes of erroneous therapy delivery

Patient	Sex, age	ICD models	Ventricular leads	Causes of inappropriate discharges
1	M, 51 years	Ela Medical Defender I 9001	Biotronik SL-ICD 100/18 (Biotronik Inc., Berlin, Germany)	EMI from electric stove
2	M, 71 years	Telectronics Guardian 4210	Telectronics 030-575	Disconnection of an epicardial lead from the header
3	M, 71 years	Telectronics Guardian 4210	Telectronics 330-258	Disconnection of an endocardial lead from an extension adapter
4	M, 69 years	Ela Medical Defender II 9201	Enguard 040-068	EMI from electrically powered watering device
5	M, 67 years	Guidant Ventak AV 1810	Guidant CPI 0125	Oversensing of diaphragmatic myopotentials
6	M, 68 years	Ela Medical Defender I 9001	Enguard 040-068	EMI from hydro-massage bath
7	M, 70 years	Ela Medical Lyra 2020	Medtronic 6942	Endocardial ventricular lead fracture
8	M, 71 years	Ela Medical Alto DR 614	Medtronic 6942	EMI from surgical electrocautery
9	M, 69 years	St Jude Atlas VR V-199	St Jude SPL SP01	T-Wave oversensing Double ventricular counting
10	M, 71 years	Guidant Prizm II VR 1860	Guidant Reliance 0148	EMI from transcutaneous electric nerve stimulation
11	M, 71 years	Guidant Contak Renewal H135	Guidant Reliance 0148	EMI from transcutaneous electric nerve stimulation
12	M, 60 years	Ela Medical Lyra 2021	Medtronic 6942	EMI from electric pruner
13	M, 72 years	Ela Medical Defender IV 612	Telectronics 040-069	Endocardial atrial lead fracture

Inappropriate ICD shock due to EMI from Transcutaneous Electrical Nerve Stimulation (TENS)

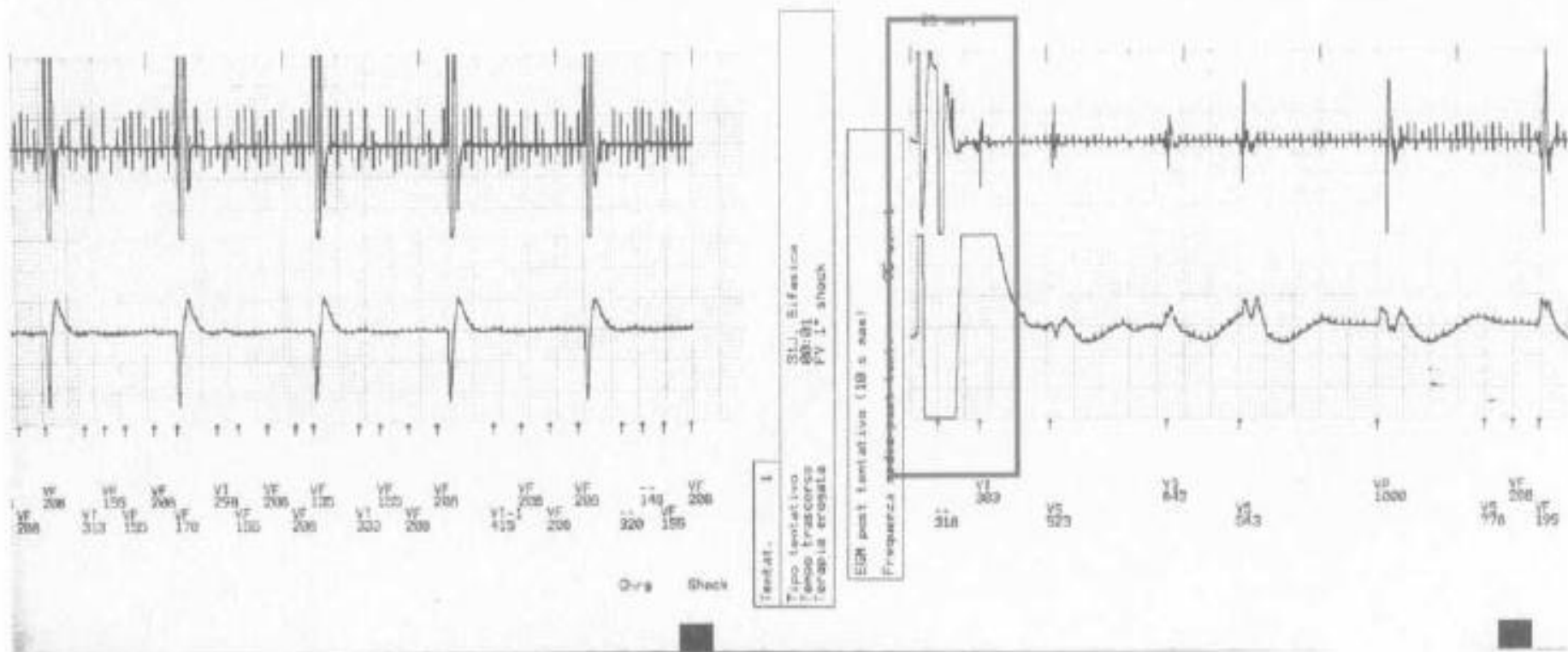


Figure 1 Spurious VF detection due to high-frequency, high-amplitude signals generated by transcutaneous electrical nerve stimulation. Stored ventricular (top line) and shocking lead (bottom line) electrogram in Patient 10. The device misinterpreted the sensed events as an episode of 'VF' and delivered the programmed therapy (31 J shock).

“NOISES” due to a bad connection between lead and extension
False VF detection and inappropriate shock
ICD site change (abdominal -> pectoral) without extension

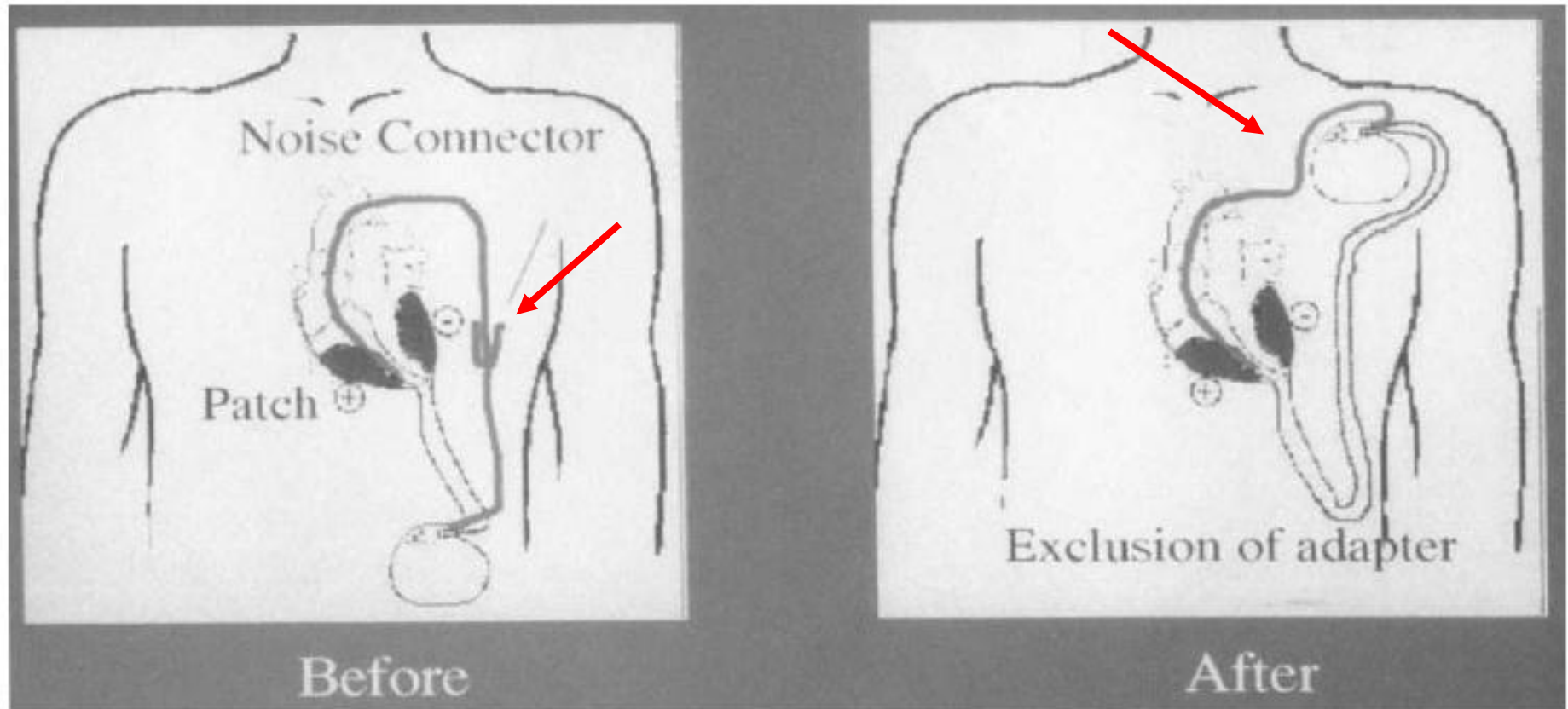


Figure 2 Patient with a single-chamber ICD. The device was first implanted in the abdomen and connected to an endocardial pacing/sensing lead through an extension adapter; two epicardial patches were also employed (*left*). After three inappropriate ICD discharges, due to noise originating from the connector, the ICD was re-implanted at the pectoral site and directly connected to the endocardial lead (*right*).

**Abdominal myopotentials misdetected as VF potentials:
pacing inhibition and inappropriate shock
New additional pacing-sensing septal lead**

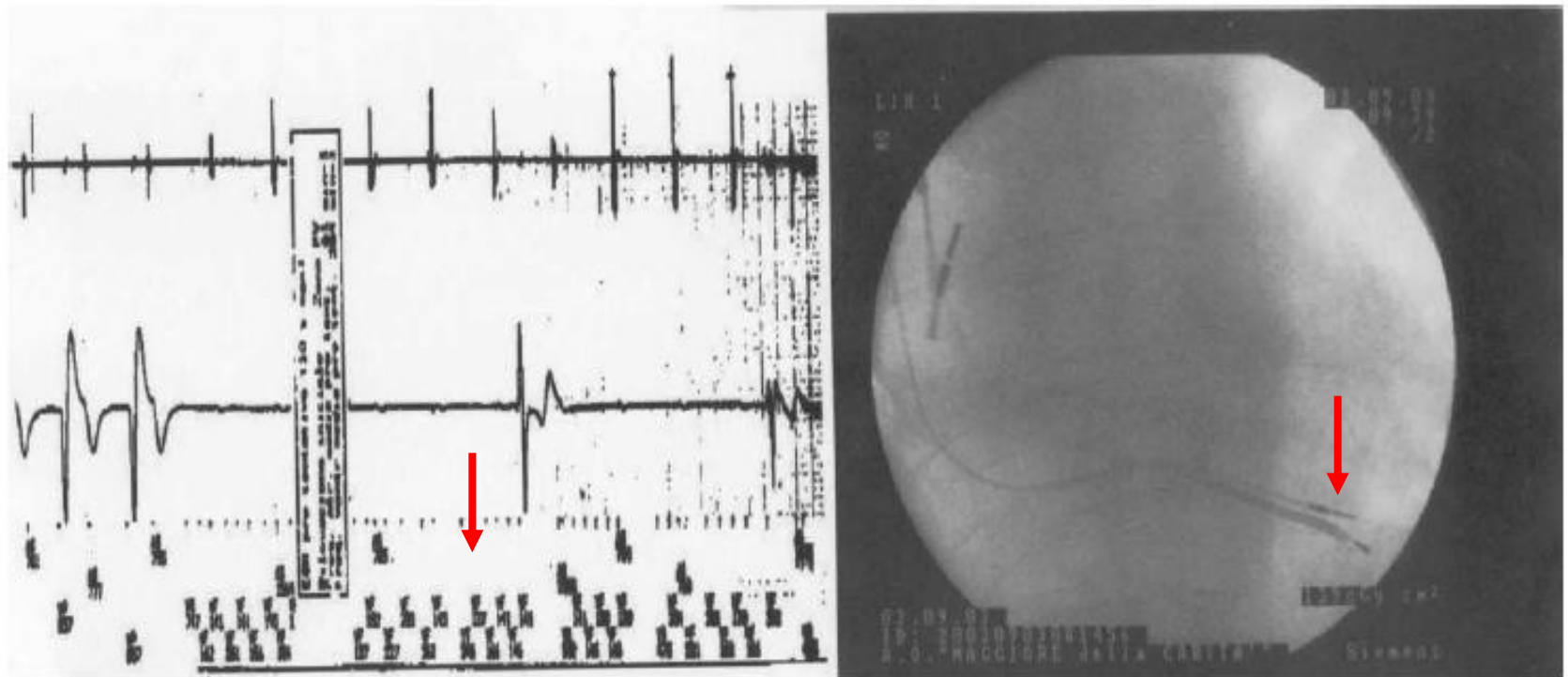


Figure 4 Patient with a dual-chamber ICD, complete AV block, and paroxysmal atrial fibrillation. Stored atrial (first line) and ventricular (second line) intracardiac electrograms reveal an inappropriate shock because of oversensing of myopotential signals. Myopotential sensing inhibited ventricular pacing and caused an inappropriate 'VF' detection, with consequent ICD discharge (left panel). Erroneous therapy delivery persisted after ventricular sensitivity reprogramming; an additional pacing/sensing lead was fixed in the low interventricular septum (chest X-ray at right panel).

TRIPLE signals detection: R1-R2-T waves

Pseudo high rate (VF zone) and inappropriate shocks

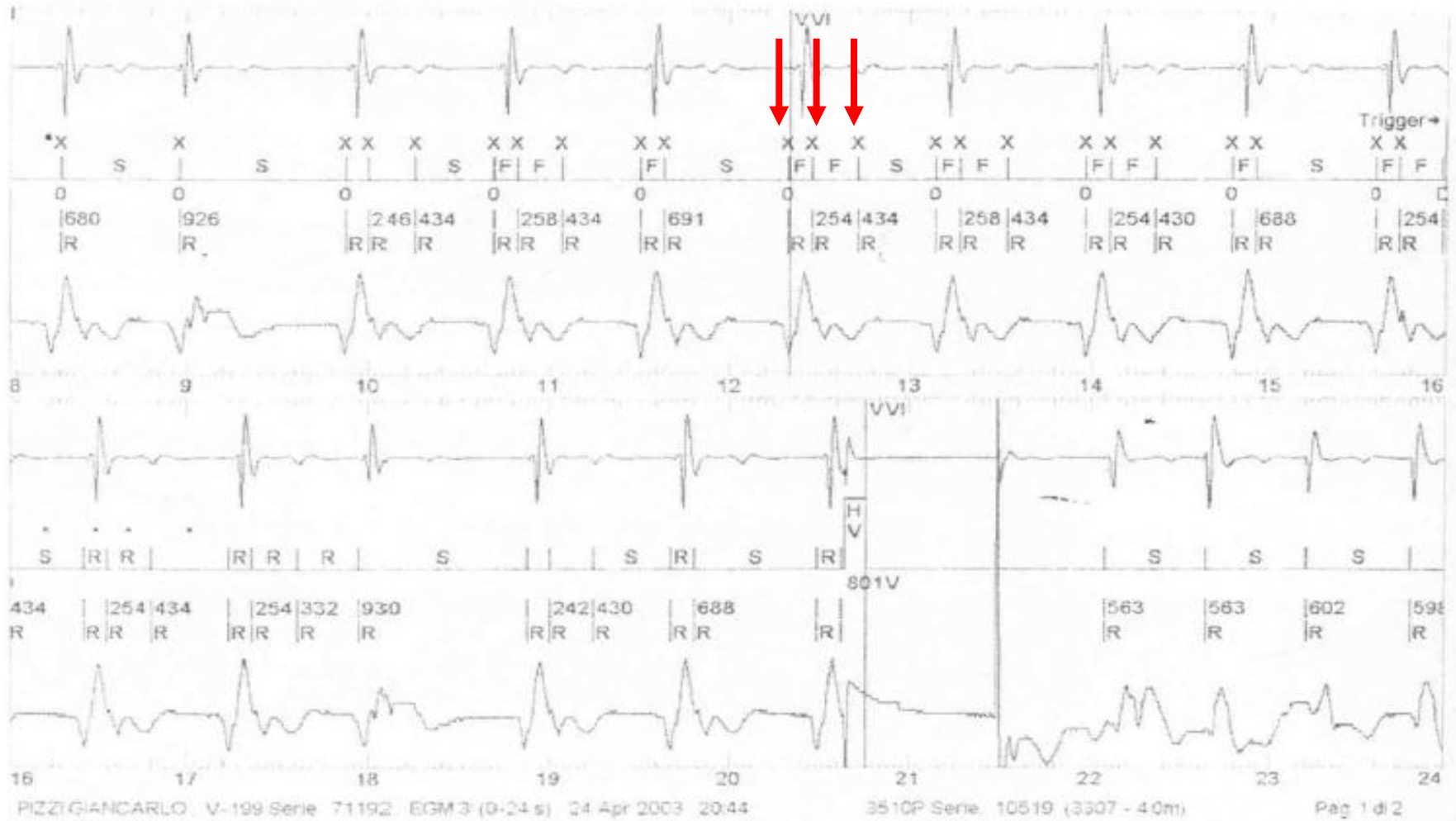
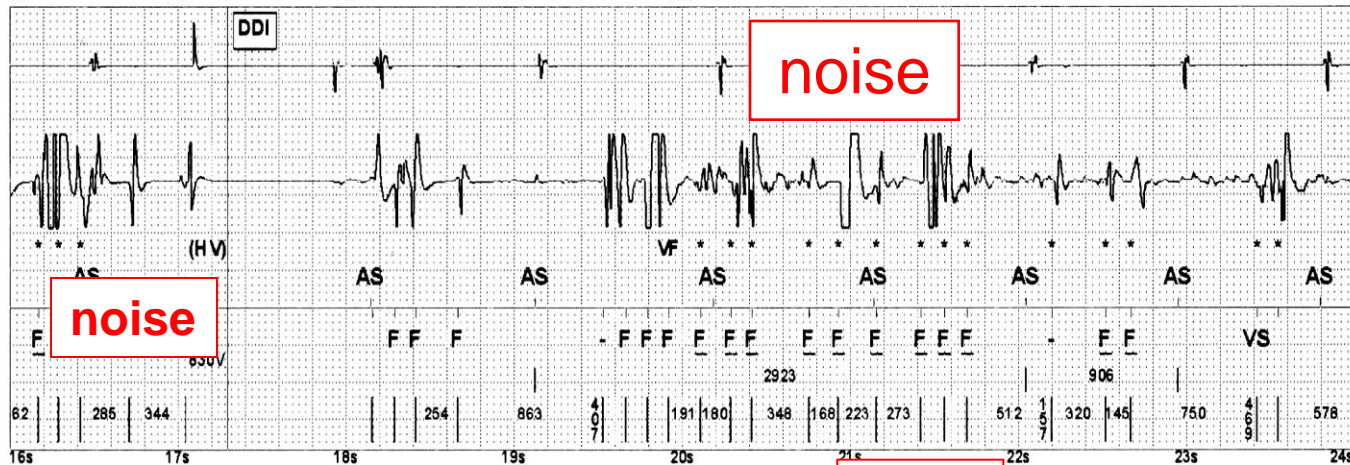
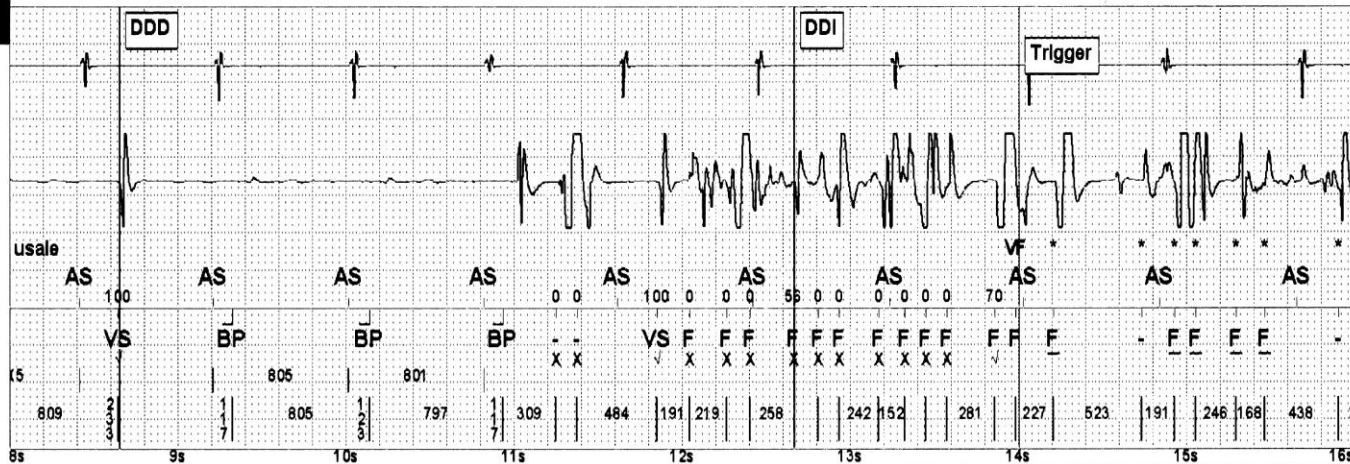


Figure 3 Stored electrogram from the event leading to inappropriate shock delivery: (ventricular channel (top line), marker channel (middle line), and defibrillator coil channel (bottom line). Double counting of native QRS complexes is followed by T-wave oversensing. The erroneous counting fulfills VF detection criteria, leading to inappropriate ICD discharge.

Partial pacing/sensing lead fracture

Continuous noises and a lot of inappropriate ICD shocks (pseudo-storm!!)



+
Dispositivo: EnTrust D154VRC
Num. di serie: PNT603987S

Data della visita: 01-Ott-2009 11:26:47
9987 Versione software 1.5
Copyright © Medtronic, Inc. 2002

Rapporto Quick Look

Pagina 4

% Stim. (% di tempo dal 15-Set-2009)

VS	100.0 %
VP	<0.1 %

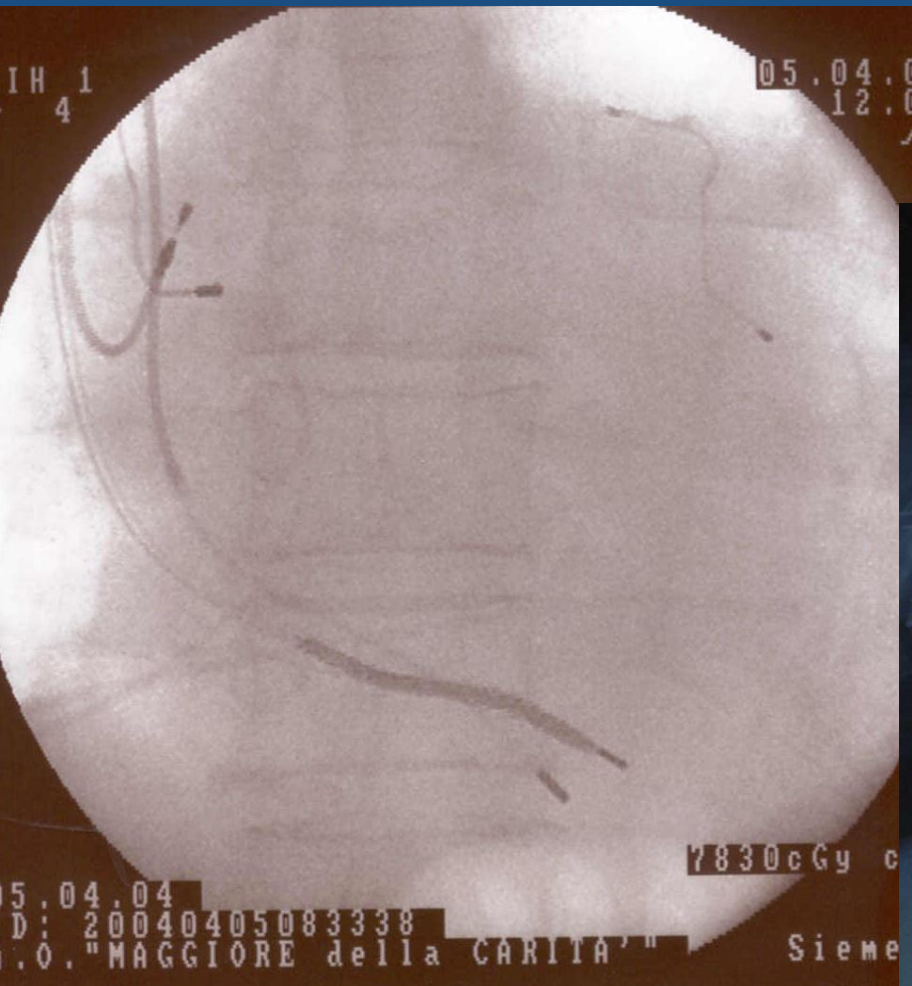
OSSERVAZIONI (2)

- Problema di sensing: 18909 intervalli V-V brevi da 21-Set-2009 23:48:58. Controllare le onde R contate doppie, l'eventuale rottura dell'elettrocattetero o l'eventuale allentamento della vite di fissaggio.
- Funzione Patient Alert: >3000 ohm imped. elettrocatt. Stim. RV.

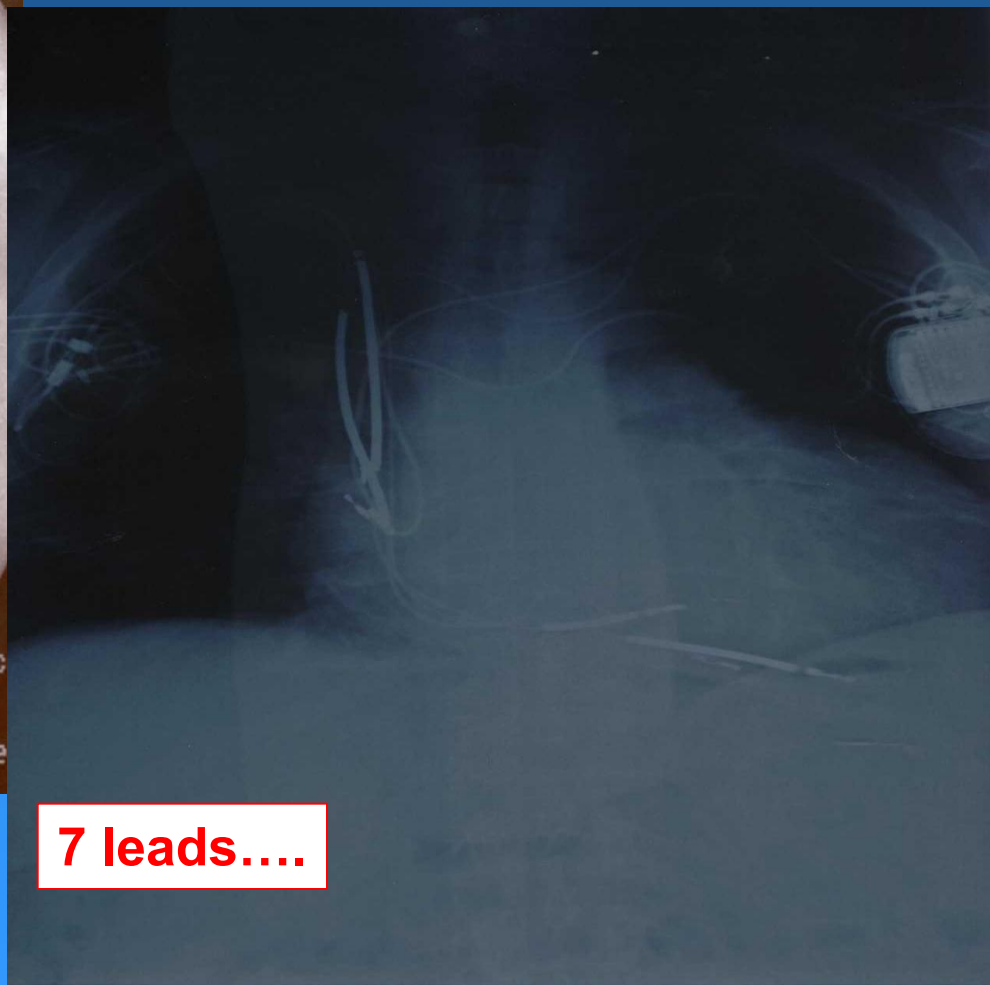
“Prevention” Algorhythm

**to early diagnose the problem and change the lead
BEFORE inappropriate ICD shocks**

Lead extraction problems ...!



5 leads.....



7 leads.....

PM/ICD leads extraction "TOOLS"



Soft-Grip



Coil Expander



Byrd Polypropylene Dilator Sheaths



Clippers



Stylet Wires



Byrd Telescoping Stainless Steel Dilators



Locking Stylet



Gauge Pin



Pin Vise

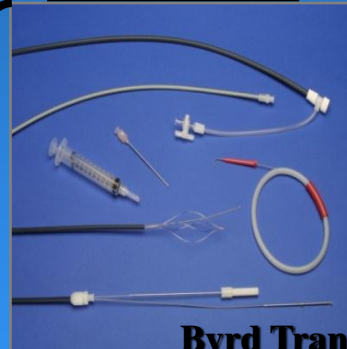
Superior approach

Mechanical Dilators to perform dilatation and countertraction



Dotter Basket

& Tip-Deflecting Wire

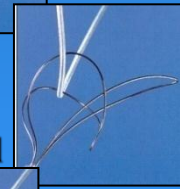
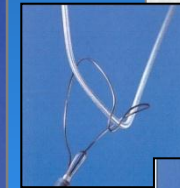


Byrd Transfemoral Workstation

Femoral approach



Curved Femoral Sheaths



Needle's Eye Snare



ELETTRIC STORM

>n°3 shock ICD/24h



Progetto Nazionale Edukarea FIAC 2010

FIAC

ECG monitoring

Interrogate the ICD

Evaluate antiarrhythmic therapy
Venous access
GIK infusion (+MgSO₂)

Wait
1th ICD intervention
to evaluate arrhythmia

Inappropriate Shock

- * Atrial Fibrillation
- * Sinus tachycardia

Well tolerated VT
(<160 bpm)

Bad tolerated VT
(> 160-200 bpm)
VT > 200/min
VF

Light anesthesia

Light anesthesia

Deep anesthesia

MAGNET ON
ICD OFF

MAGNET ON
ICD OFF

MAGNET OFF
ICD ON

Drug therapy:
Xylocaine - Amiodarone
Betablockers

Loss of consciousness
MAGNET OFF
ICD ON

RCP
(BLS-ALS)

Management of patients receiving implantable cardiac defibrillator shocks

Recommendations for acute and long-term patient management

Frieder Braunschweig (Chair)^{1*}, Giuseppe Boriani (Co-chair)², Alexander Bauer³, Robert Hatala⁴, Christoph Herrmann-Lingen⁵, Josef Kautzner⁶, Susanne S. Pedersen⁷, Steen Pehrson⁸, Renato Ricci⁹, and Martin J. Schalij¹⁰

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²Department of Cardiology, San Filippo

Online publish-ahead-of-print 25 October 2010



Figure 2 Placement of magnet. A pacemaker magnet is placed and fixated over the ICD device. During magnet placement, tachycardia treatments are inhibited while pacemaker functions are preserved. See also Table 2.

gna, Bologna, Italy; ³Department of
ent of Psychosomatic Medicine and
rtment of Medical Psychology and
et, Copenhagen, Denmark;
n, The Netherlands

MAGNET application to temporarily deactivated Cardiac Rhythm Management Devices (PM/ICD) (Europace 2011)



Europace (2011) 13, 1222–1230
doi:10.1093/europace/eur137

REVIEW

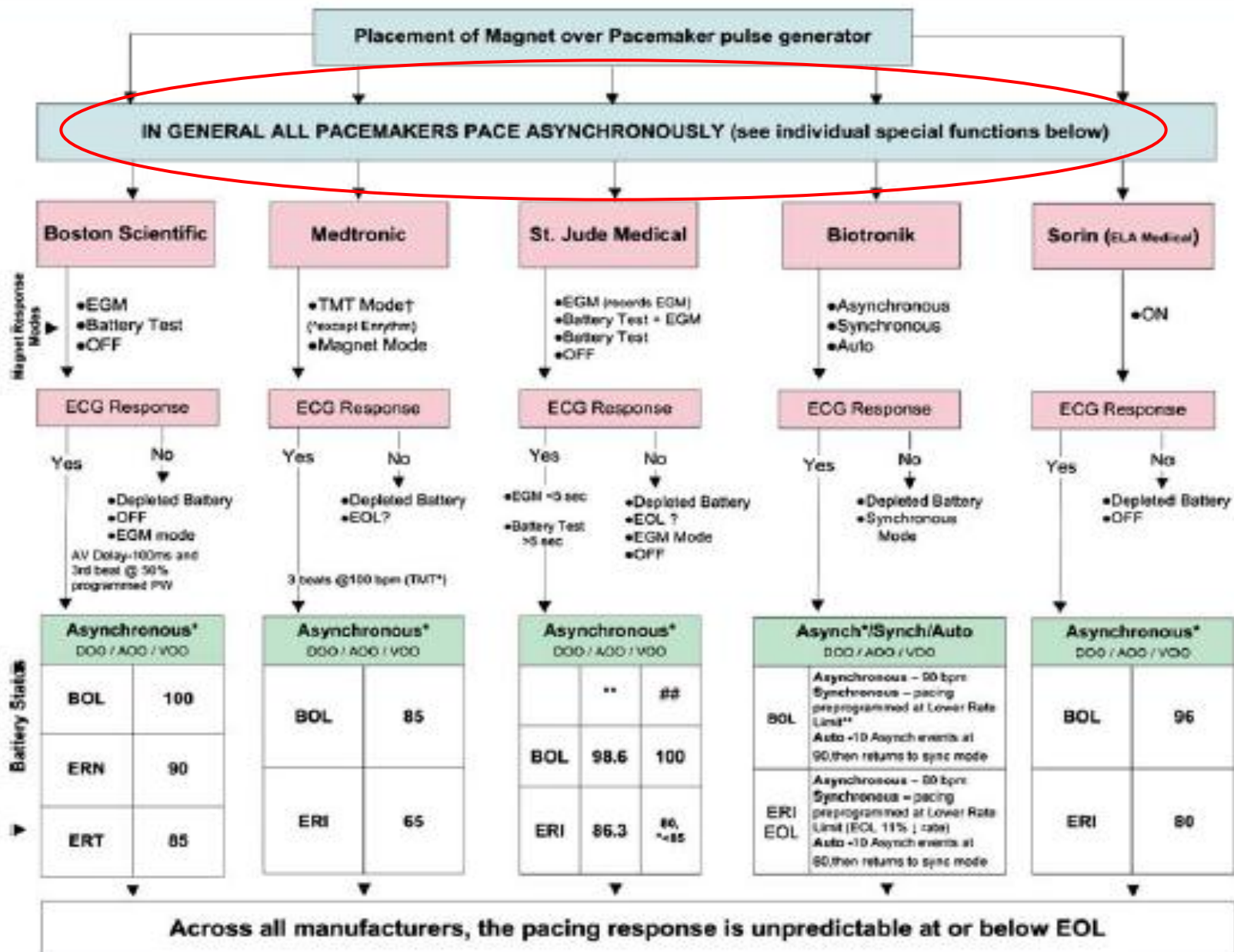
Clinical applications of magnets on cardiac rhythm management devices

Sony Jacob^{1*}, Sidakpal S. Panaich¹, Rahul Maheshwari², John W. Haddad³, Benzy J. Padanilam⁴, and Sinoj K. John⁵

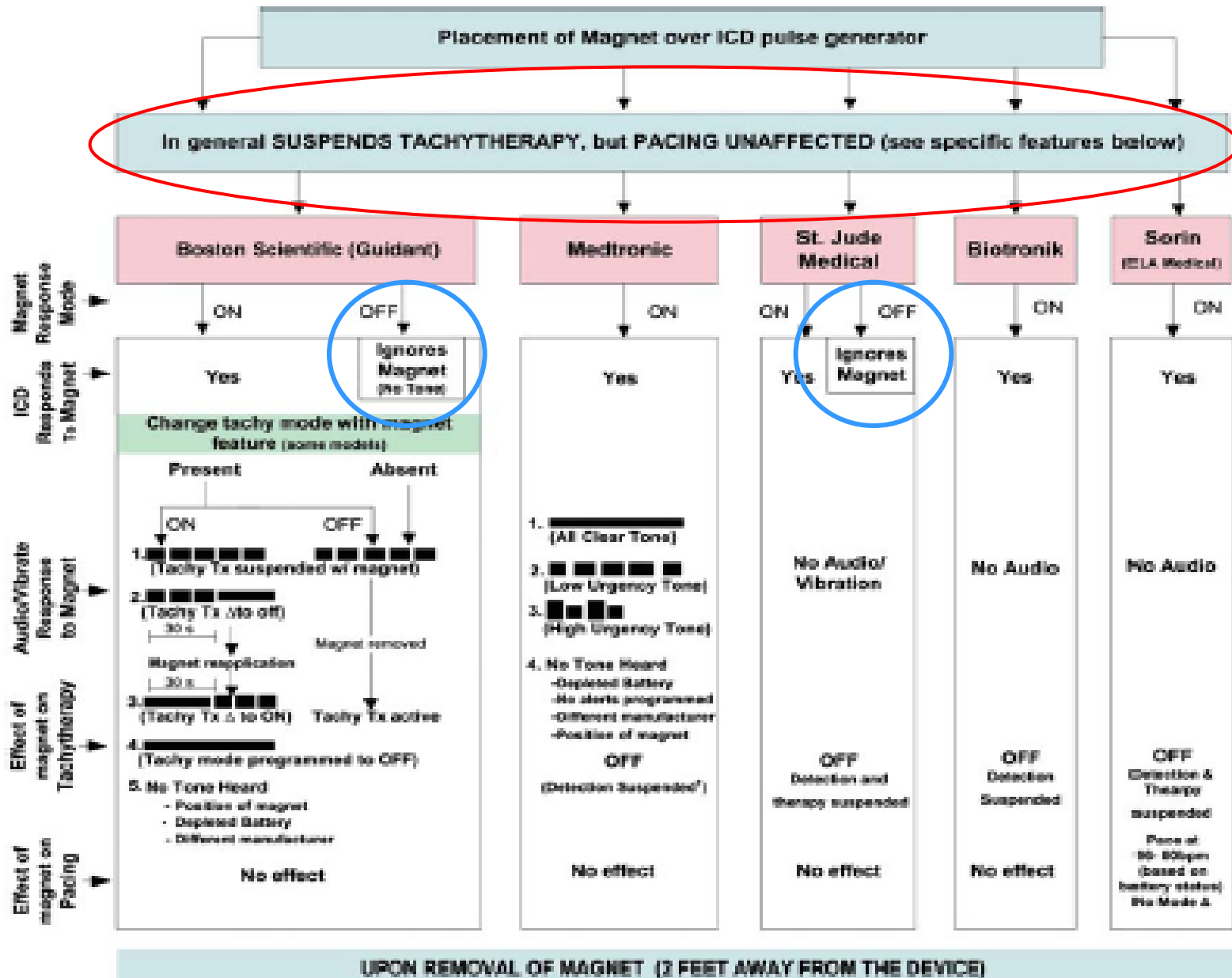
¹Division of Cardiology/Electrophysiology, Department of Internal Medicine, Harper University Hospital, Wayne State University, Detroit, MI 48201, USA; ²Wayne State University School of Medicine, Detroit, MI 48201, USA; ³Department of Anesthesiology, Harper University Hospital, Detroit, MI 48201, USA; ⁴Division of Cardiology & Electrophysiology, St Vincent Medical Group, Indianapolis, IN 46260, USA; and ⁵Department of Anesthesiology and Critical Care, Dartmouth-Hitchcock Medical Center, One Medical Center Drive, Lebanon, NH 03756, USA

Received 25 January 2011; accepted after revision 6 April 2011; online publish-ahead-of-print 26 May 2011

MAGNET application to temporary change PM function (Europace 2011)



MAGNET application to temporarily deactivated ICD tachyarrhythmias therapy



Are complications of implantable defibrillators under-estimated and benefits over-estimated?

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Department of Cardiology, Arrhythmologic Centre, Ospedali del Tigullio, 16033 Lavagna, Italy

Received 19 April 2009; accepted after revision 6 June 2009; online publish-ahead-of-print 4 July 2009

Key points

- Implantable cardioverter defibrillator (ICD) therapy has clearly been shown to be effective in aborting sudden arrhythmic death and consequently reducing total mortality. However, the extent to which this capability, which modestly prolongs life, outweighs potential adverse effects on morbidity, quality of life, and the mode of death is less clear.
- ICD insertion is unlike an ‘insurance policy,’ as patients who do not benefit from device therapy are still exposed to procedural and device-related complications.



Thank you

- Many patients with current indications for ICD implantation may not benefit from this invasive therapy and a better risk stratification is needed to optimize patient selection.
- A reappraisal of the benefits and potential hazards of ICD therapy will enable physicians to have a more mutually informed and balanced dialogue with their patients.