PLACE

PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

ROMA
Centro Congressi
di Confindustria
Auditorium
della Tecnica

9ª Edizione

30 Settembre
1 Ottobre
2022

Cardiopatie Congenite

PACING E SICD NEI CONGENITI

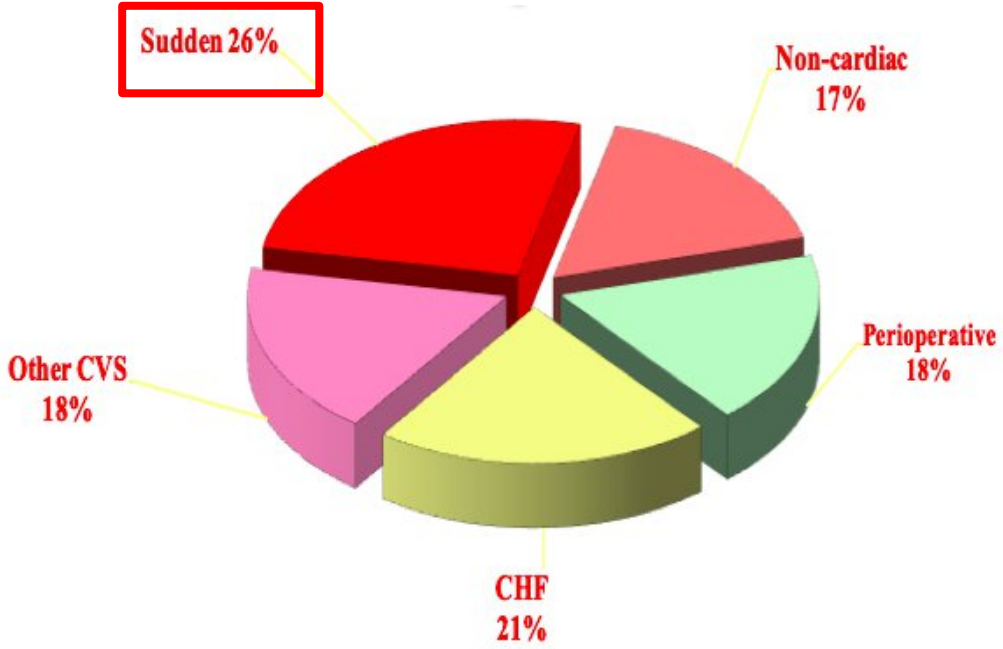
Berardo Sarubbi

UOSD Cardiopatie Congenite dell'Adulto

A.O.R.N. dei Colli - Ospedale Monaldi - Napoli

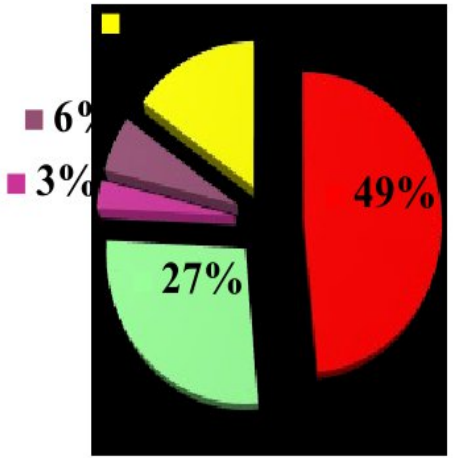
www.berardosarubbi.it

Causes of Death in GUCH



Oechsling et al Am J Cardiol 2000

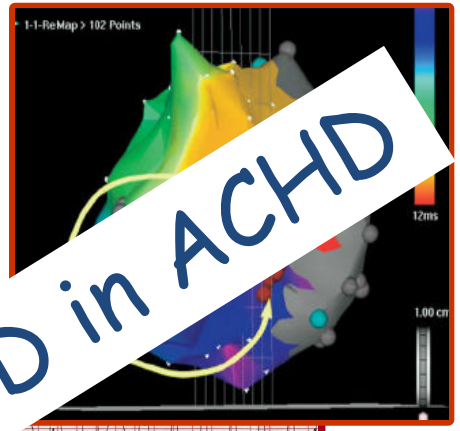
Late Death in Repaired Tetralogy

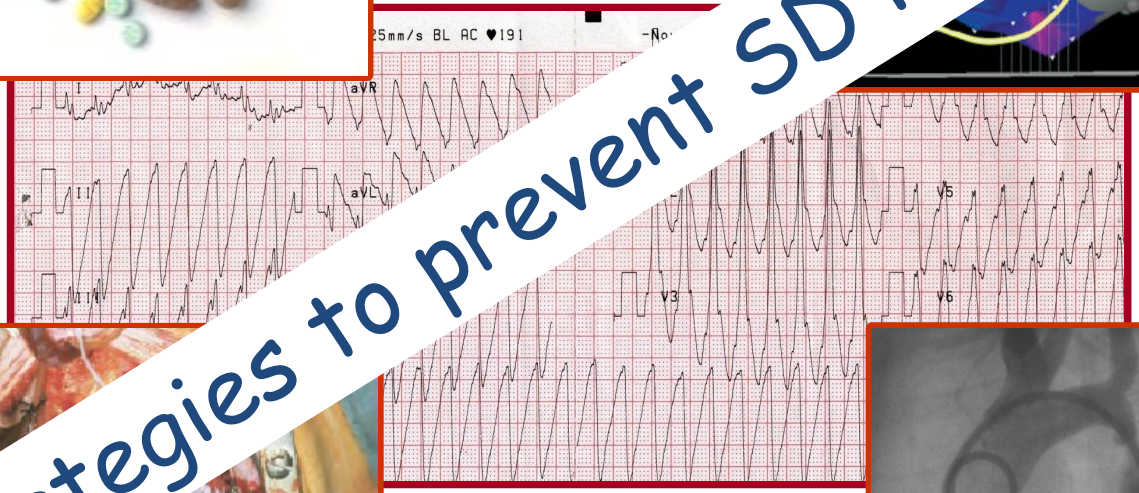


793 adult pts (1985-95)
33 pts died (4.2% mortality)

Gatzoulis et al Lancet 2000

Strategies to prevent SD in ACHD



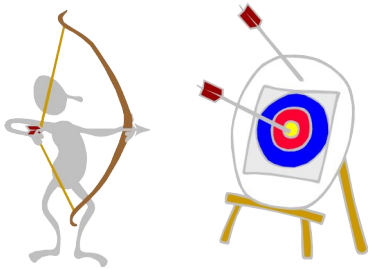


Recommendations for treatment of arrhythmias ACHD (3)

ESC European Society of Cardiology

Recommendations	Class	Level
Implantable Cardiac Defibrillator		
ICD implantation is indicated in adults with CHD who are survivors of an aborted cardiac arrest due to VF or haemodynamically untolerated VT after evaluation to define the cause of the event and exclusion of reversible causes.	I	C
ICD implantation is indicated in adults with CHD and sustained VT after haemodynamic evaluation and repair when indicated. EP evaluation is required to identify patients in whom catheter ablation or surgical ablation may be beneficial as adjunctive treatment or in whom it may offer a reasonable alternative.	I	C

2020 ESC Guidelines for the management of adult congenital heart disease (ACHD)
(European Heart Journal 2020 - doi/10.1093/eurheartj/ehaa554)



Issues for the use of ICD in ACHD

- ✓Indications
- ✓Inappropriate shocks and lead failure
- ✓Unique anatomical situations in CHD
- ✓Technical difficulties

Morbidity associated with ICDs in TOF – inappropriate therapies and lead fracture

Implantable cardioverter-defibrillator therapy in adult patients with tetralogy of Fallot

Klaus K. Witte*, Christopher B. Pepper, J. Campbell Cowan, John D. Thomson, Kate M. English, and Michael E. Blackburn

Departmen

Received 1 De

European Heart Journal (2007) 28, 1854–1861
doi:10.1093/eurheartj/ehl306

Clinical research
Arrhythmia/electrophysiology

Outcome of implantable cardioverter defibrillators in adults with congenital heart disease: a multi-centre study

Sing-Chien Yap[1]*,
Hubert W. Vliege
and Willem Drent

Journal of the American College of Cardiology
© 2008 by the American College of Cardiology Foundation
Published by Elsevier Inc.
Vol. 51, No. 17, 2008
ISSN 0735-1097/08/$34.00
doi:10.1016/j.jacc.2008.01.033

Heart Rhythm Disorders

Results of a Multicenter Retrospective Implantable Cardioverter-Defibrillator Registry of Pediatric and Congenital Heart Disease Patients

Charles I. Berul, MD,* George F. Van Hare, MD,†‡ Naomi J. Kertesz, MD,§ Anne M. Dubin, MD,† Frank Cecchin, MD,* Kathryn K. Collins, MD,‖ Bryan C. Cannon, MD,§ Mark E. Alexander, MD,* John K. Triedman, MD,* Edward P. Walsh, MD,* Richard A. Friedman, MD§
Boston, Massachusetts; Palo Alto and San Francisco, California; and Houston, Texas

Inappropriate shock:
10 % SCD-HEFT
21 % Paed ICD Registry
25 % rTOF Leeds
30-40 % rTOF Euroheart survey

14% lead failure
Berul CI et al. JACC 2008

9.1% lead fracture in TOF
Khairy P et al. Circulation 2008

Congenital Heart Disease

Implantable Cardioverter-Defibrillators in Tetralogy of Fallot

Paul Khairy, MD, PhD; Louise Harris, MD; Michael J. Landzberg, MD; Sangeetha Viswanathan, MRCPCH; Amanda Barlow, MD; Michael A. Gatzoulis, MD; Susan M. Fernandes, MHP, PA-C; Luc Beauchesne, MD; Judith Therrien, MD; Philippe Chetaille, MD; Elaine Gordon, MD; Isabelle Vonder Muhll, MD; Frank Cecchin, MD

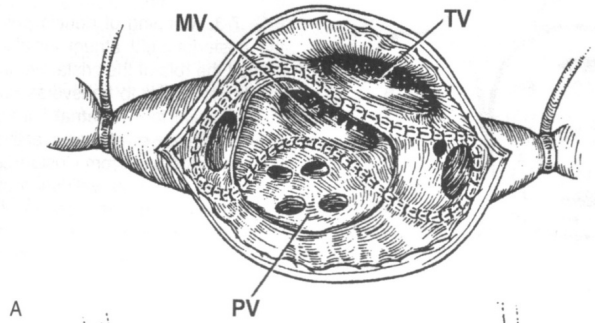
High Failure Rate for an Epicardial Implantable Cardioverter-Defibrillator Lead: Implications for Long-Term Follow-Up of Patients With an Implantable Cardioverter-Defibrillator

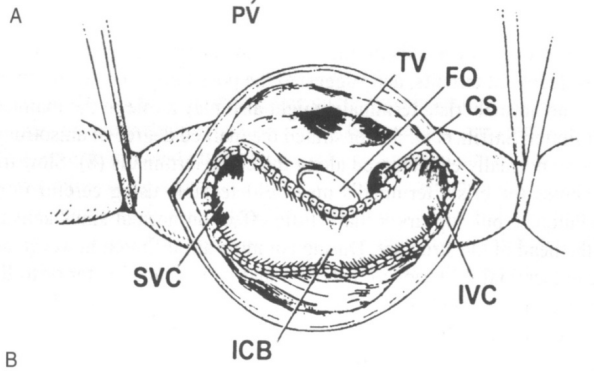
PETER A. BRADY, MB, MRCP, PAUL A. FRIEDMAN, MD, JANE M. TRUSTY, RN, SUELLEN GRICE, RN, STEPHEN C. HAMMILL, MD, FACC, MARSHALL S. STANTON, MD, FACC

Rochester, Minnesota

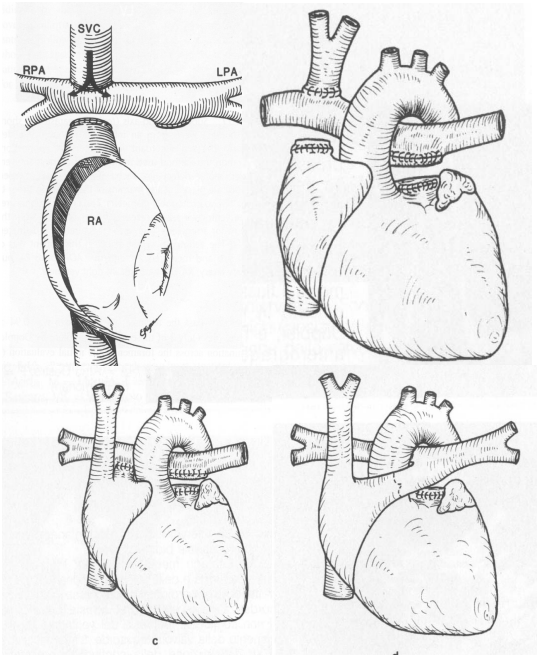
- ✓Epicardial lead malfunction is common on long -term follow-up.
- ✓Some leads have a failure of 28% at 4yrs

TGA s/p Mustard/Senning

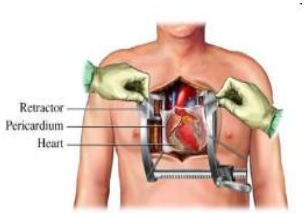


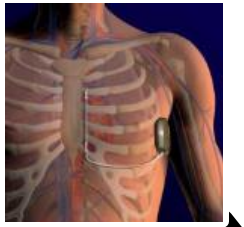


s/p Fontan



Cardiac Defibrillator Therapy





195
Paul Zoll
1st human external defibrillation

198
1st human implant of AICD

198
8
1st human implant of endocardial shocking lead
Eliminated need for thoracotomy

2008
S-ICD

EMBLEM™ S-ICD System

20% reduction in Device Profile

20% reduction in device profile

Longevity > 7,3 yrs

2 year improvement in projected longevity with Boston Scientific battery technology[2]

Compatible Latitude

LATITUDE Remote Patient Management Enabled[2]

2015

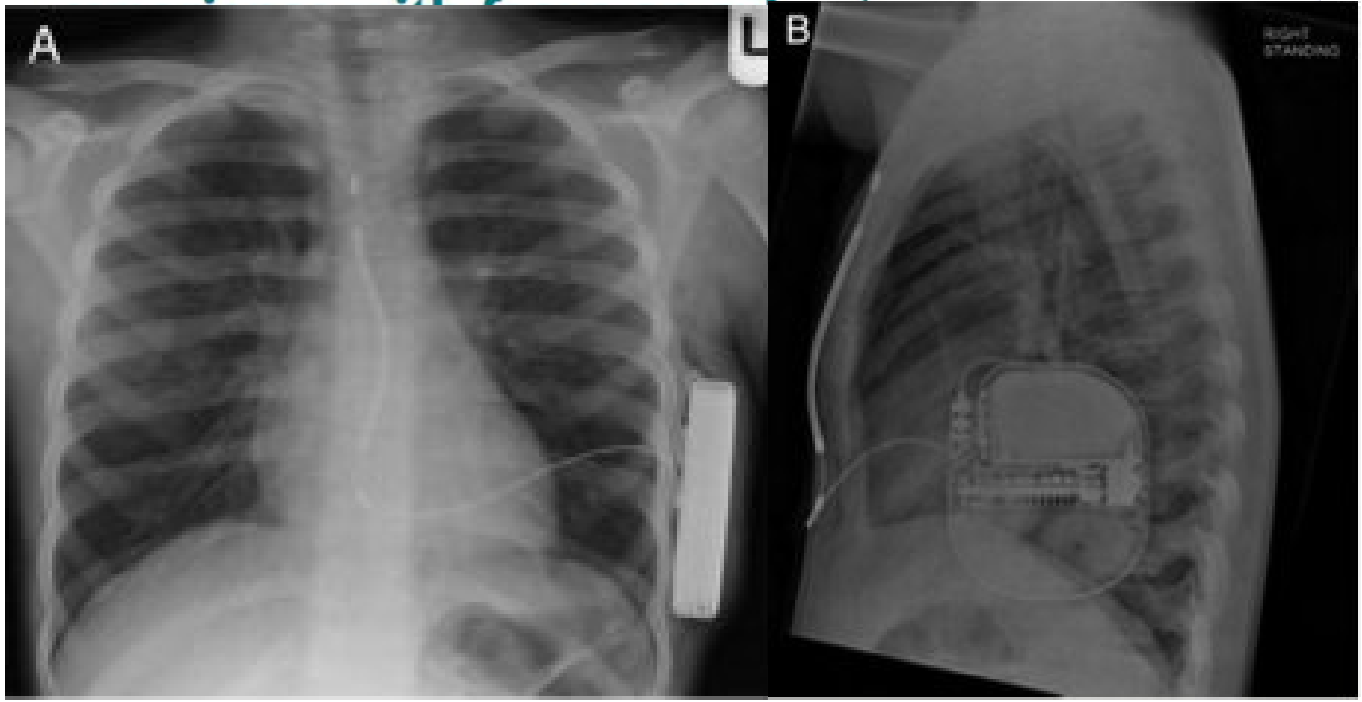
Table 2. Characterization of Patient Groups for S-ICD Implantation

S-ICD is preferred device
No venous access (occluded veins or congenital anomalies)
High risk of complications for transvenous systems have (dialysis, pediatric, and immunocompromised)
Channelopathies (long-QT syndrome, Brugada, hypertrophic cardiomyopathy)
Previous device infections or lead failures
History of endocarditis
S-ICD should be strongly considered
Young patients
Life expectancy >10 y
Primary prevention indicated patients with ischemic/nonischemic heart failure
Prosthetic valves
Women (preferred generator placement lateral wall)
Selected secondary prevention indicated patients (survivors of out-of-hospital VF, no evidence of monomorphic VT
S-ICD should be avoided
Systolic heart failure and LBBB who are indicated for CRT
Symptomatic bradycardia requiring pacemaker
Recurrent sustained monomorphic VT for whom ATP is deemed appropriate

siol. 2013

Europace (2013) **15**, 523–530
doi:10.1093/europace/eus388

Implantable cardioverter defibrillator therapy in paediatric practice: a single-centre UK



Circulation Journal 2016
Official Journal of the Japanese Circulation Society

ORIGINAL ARTICLE

ESC European Society of Cardiology

Europace (2018) **0**, 1–8
doi:10.1093/europace/euy139

CLINICAL RESEARCH

Subcutaneous implantable cardioverter-defibrillator: is it ready for use in children and young adults? A single-centre study

Massimo Stefano Silvetti[1], Vincenzo Pazzano[1], Letizia Verticelli[1], Irma Battipaglia[1], Fabio Anselmo Saputo[1], Sonia Albanese[2], Mariolina Lovecchio[3], Sergio Valsecchi[2], and Fabrizio Drago[1]

Table I **Baseline patient characteristics and therapy**

No.	Gender	Arrhythmia symptom	Age (years)	Height (cm)	Weight (kg)	BSA (m^2)	BMI	Heart disease	LVEF (%)	Prevention	Drugs
1	Male	SND, AFl, NSVT	30	175	83	2.03	27.1	TGA s/p Mustard	32	Primary	Carvedilol, ASA
2	Male	SND, AFl, NSVT	29	180	70	1.86	21.6	TGA s/p Mustard	49	Primary	Sotalol, ASA, ACEI
3	Female	NSVT	17	174	82	2.01	27.1	ARVC	50	Primary	Sotalol
4	Male	NSVT	10	139	38	1.23	19.7	Familial HOCM	60	Primary	Metoprolol, ASA
5	Female	PVC	15	153	43	1.36	18.4	AT, TGA s/p Glenn	20	Primary	Carvedilol, OAT, Digoxin
6	Female	NSVT, syncope	15	142	49	1.43	24.3	ARVC	45	Primary	Carvedilol, ACEI
7	Female	NSVT	14	169	52	1.55	18.2	Familial HNOCM	68	Primary	Metoprolol
8	Female	No	11	156	52	1.52	21.4	Familial HNOCM	65	Primary	Metoprolol
9	Female	VT, CA	15	164	75	1.88	27.9	Familial ARVC	40	Secondary	Amiodarone, ASA
10	Female	SND, VT, syncope	28	160	65	1.73	25.4	UVH s/p Fontan	38	Primary	Carvedilol, OAT
11	Male	LQT >500 ms	15	170	55	1.60	19.0	LQTS2	68	Primary	Propranolol Mexiletin
12	Male	NSVT	31	170	60	1.69	20.8	PA, VSD, MAPCA s/p repair, PH	35	Primary	Metroprolol, Sildenafil Diuretics
13	Female	NSVT, syncope	20	171	62	1.72	21.2	Familial ARVC	50	Primary	Nadolol
14	Female	VF inducible	10	151	61	1.64	26.8	ARVC	47	Primary	Carvedilol
15	Female	PVC	15	166	58	1.63	20.7	ALCAPA, DCM	29	Primary	Carvedilol, ACEI, ASA, Diuretics, Ivabradin

Journal of Interventional Cardiac Electrophysiology
https://doi.org/10.1007/s10840-021-00966-4

Subcutaneous implantable cardioverter defibrillator in children and adolescents: results from the S-ICD "Monaldi care" registry

Berardo Sarubbi[1] · Diego Colonna[1] · Anna Correra[1] · Emanuele Romeo[1] · Michele D'Alto[1] · Maria Teresa Palladino[2] · Salvatore Virno[1] · Antonio D'Onofrio[3] · Maria Giovanna Russo[2]

Received: 10 May 2020 / Accepted: 15 February 2021

- 297 patients enrolled in the S-ICD "Monaldi care"
  April 2014 to June 2020
- 21 consecutive children and adolescents
- mean age 13.9 years, range 8-18 years
- mean body weight 59.3 kg, range 38-100 kg
- Mean follow-up 41.9±21.9 months.

Table 2 Procedural data and outcome

Pt.	Previous device	Years of implant S-ICD type	Sensing vectors	Incision type	Lead position	SICD position	Conditional shock zone/ shock zone	Intra-op. def. test	Complications	AS	IAS	F-U months	Outcome
#1	No	2018/emblem A219	3	2	Left	Left/Intermusc	220/250 bpm	Yes	None	No	No	24	Good
#2	No	2015/emblem A209	1	3	Left	Left/Intermusc	220/250 bpm	Yes	None	No	No	64	Good
#3	No	2014/emblem A209	3	3	Left	Left/Intermusc	220/250 bpm	No (no induc.)	None	No	No	78	Good SICD replaced (2020) Emblem A219
#4	No	2017/emblem A219	3	2	Left	Left/Intermusc	220/250 bpm	Yes	None	No	No	35	Good
#5	No	2016/emblem A209	3	2	Right	Left/Intermusc	220/250 bpm	Yes	None	No	Yes (double count)	55	Good
#6	No	2016/emblem A209	2	2	Left	Left/Subcut	220/250 bpm	Yes	None	No	No	55	Good
#7	No	2017/emblem A219	3	2	Left	Left/Intermusc	200/250 bpm	Yes	None	Yes	No	41	Good
#8	No	2019/emblem A219	2	2	Left	Left/Intermusc	200/250 bpm	No (no induc.)	None	No	No	18	Good
#9	No	2019/emblem A219	3	2	Left	Left/Intermusc	200/250 bpm	No (low EF)	None	No	No	16	Good
#10	No	2019/emblem A219	2	2	Right	Left/Intermusc	220/250 bpm	Yes	None	No	No	16	Good
#11	No	2019/emblem A219	3	2	Left	Left/Intermusc	200/250 bpm	Yes	None	No	No	20	Good
#12	No	2014/emblem A219	1	3	Left	Left/Subcut	220/250 bpm	Yes	None	No	No	70	Good
#13	No	2019/emblem A219	2	2	Left	Left/Intermusc	200/250 bpm	Yes	Skin erosion/-infection	No	No	15	Good
#14	No	2016/emblem A209	2	2	Left	Left/Intermusc	200/250 bpm	Yes	None	Yes	Yes (double count)	36	Reposition lead implant ICD
#15	No	2017/emblem A219	1	2	Left	Left/Intermusc	200/250 bpm	Yes	None	No	Yes (atrial arrhyth)	40	Good
#16	No	2016/emblem A209	3	2	Left	Left/Intermusc	220/250 bpm	Yes	None	No	No	55	Good
#17	No	2014/emblem A209	3	3	Left	Left/Subcut.	200/220 bpm	Yes	None	No	No	75	Good
#18	No	2020/emblem A219	3	2	Left	Left/Intermusc	200/250 bpm	Yes	None	No	No	6	Good
#19	Yes	2020/emblem A219	2	2	Right	Left/Intermusc	200/250 bpm	No (no induc.)	None	No	No	7	Good
#20	No	2020/emblem A219	2	2	Left	Left/Intermusc	230/250 bpm	No (no induc.)	None	No	No	4	Good
#21	No	2020/emblem A219	2	2	Left	Left/Intermusc	230/250 bpm	Yes	None	No	Yes (double count)	4	Good

Intermusc, intermuscular; Subcut, subcutaneous; EF, ejection fraction; AS, appropriate shock; IAS, inappropriate shock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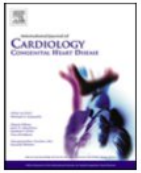
Acq.: Apr 24, 20
Acq.: 09:39:32.0000
Paolo C. 14 yrs, 38kg
Series Nb

International Journal of Cardiology Congenital Heart Disease 3 (2021) 100091

Contents lists available at ScienceDirect

International Journal of Cardiology Congenital Heart Disease

journal homepage: www.journals.elsevier.com/international-journal-of-cardiology-congenital-heart-disease

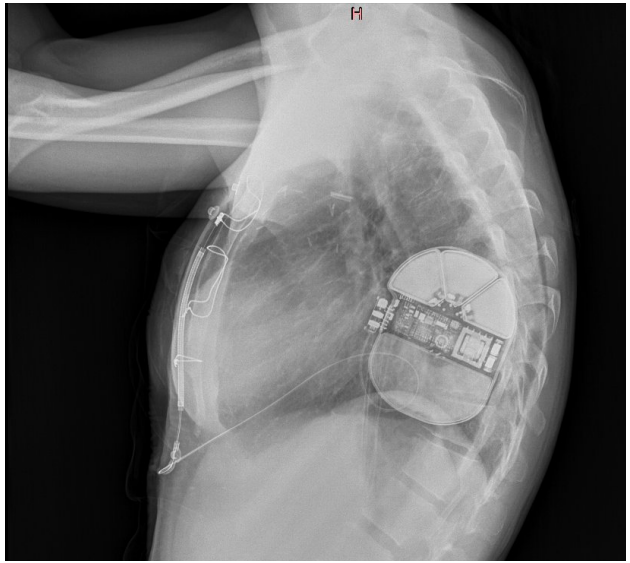


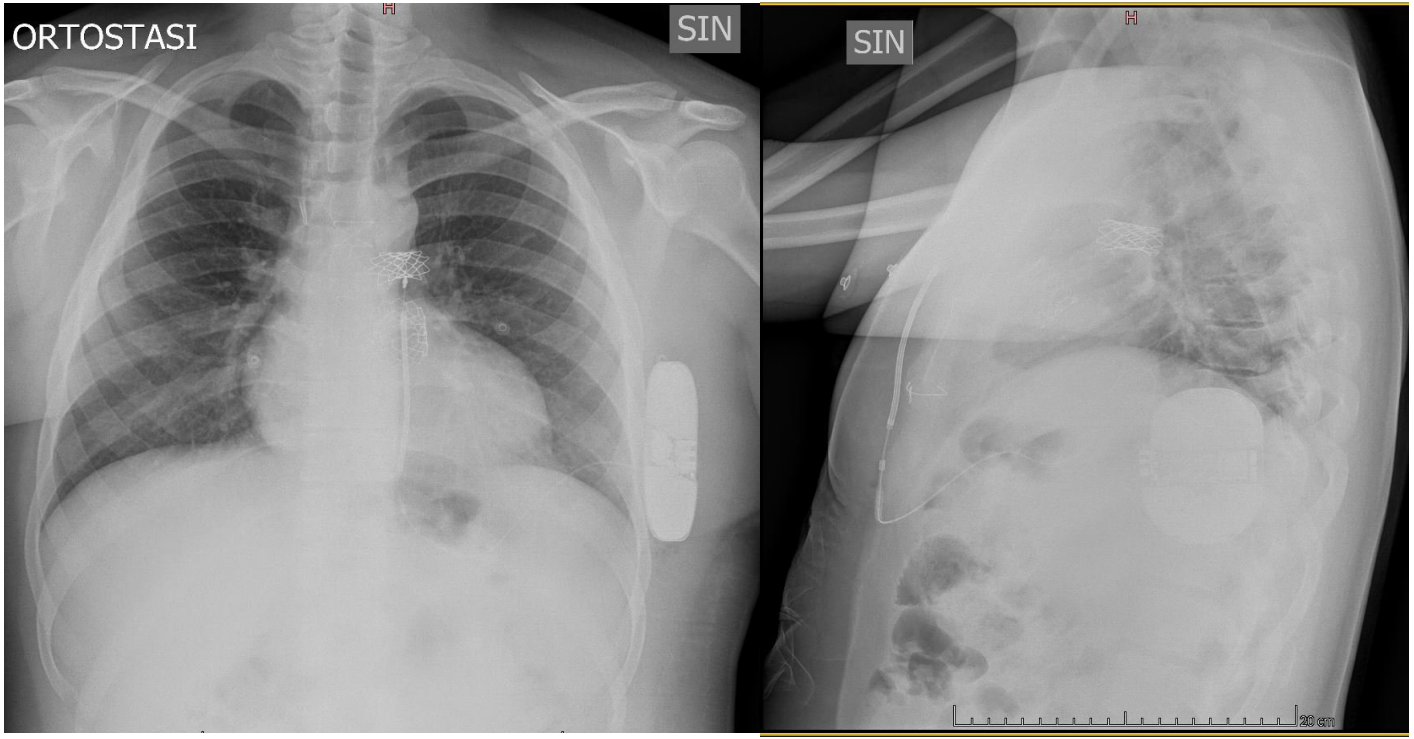
Subcutaneous implantable cardioverter defibrillator in complex adult congenital heart disease. Results from the S-ICD *"Monaldi Care"* registry

Berardo Sarubbi [a,*], Anna Correra [a], Diego Colonna [a], Emanuele Romeo [a], Michela Palma [a], Assunta Merola [a], Michele D'Alto [b], Giancarlo Scognamiglio [a], Flavia Fusco [a], Rosaria Barracano [a], Nunzia Borrelli [a], Nicola Grimaldi [a], Antonio D'Onofrio [c], Maria Giovanna Russo [d]

[a] *Adult Congenital Heart Disease Unit, Monaldi Hospital, Naples, Italy*
[b] *Cardiology Unit. "L.Vanvitelli" University, Monaldi Hospital, Naples, Italy*
[c] *Electrophysiology and Cardiac Pacing Unit, Monaldi Hospital, Naples, Italy*
[d] *Paediatric Cardiology Unit. "L.Vanvitelli" University, Monaldi Hospital, Naples, Italy*

- From a cohort of 297 pts enrolled in the S-ICD "Monaldi care" registry
- 14 consecutive complex ACHD patients (aged 35.9 +/- 16.7 years).
- All the patients showed a good compliance to the device system with no complications (infections or skin erosions).
- Four patients were listed for heart transplantation (HTX).




ORTOSTASI
SIN
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20 cm

Impact of S-ICD vs ICD in **ACHD patients**

Data from "Monaldi Care Registry"
"ACHD population subset"

No significant Differences in terms of:

- Hospital care
- Time for procedure
- Acute complicantions
- Early/Late complications

- ……

Unpublished data


6 hours after implant

Good Cosmetic Outcome

Table 2. Characterization of Patient Groups for S-ICD Implantation

S-ICD is preferred device
No venous access (occluded veins or congenital anomalies)
High risk of complications for transvenous systems have (dialysis, pediatric, and immunocompromised)
Channelopathies (long-QT syndrome, Brugada, hypertrophic cardiomyopathy)
Previous device infections or lead failures
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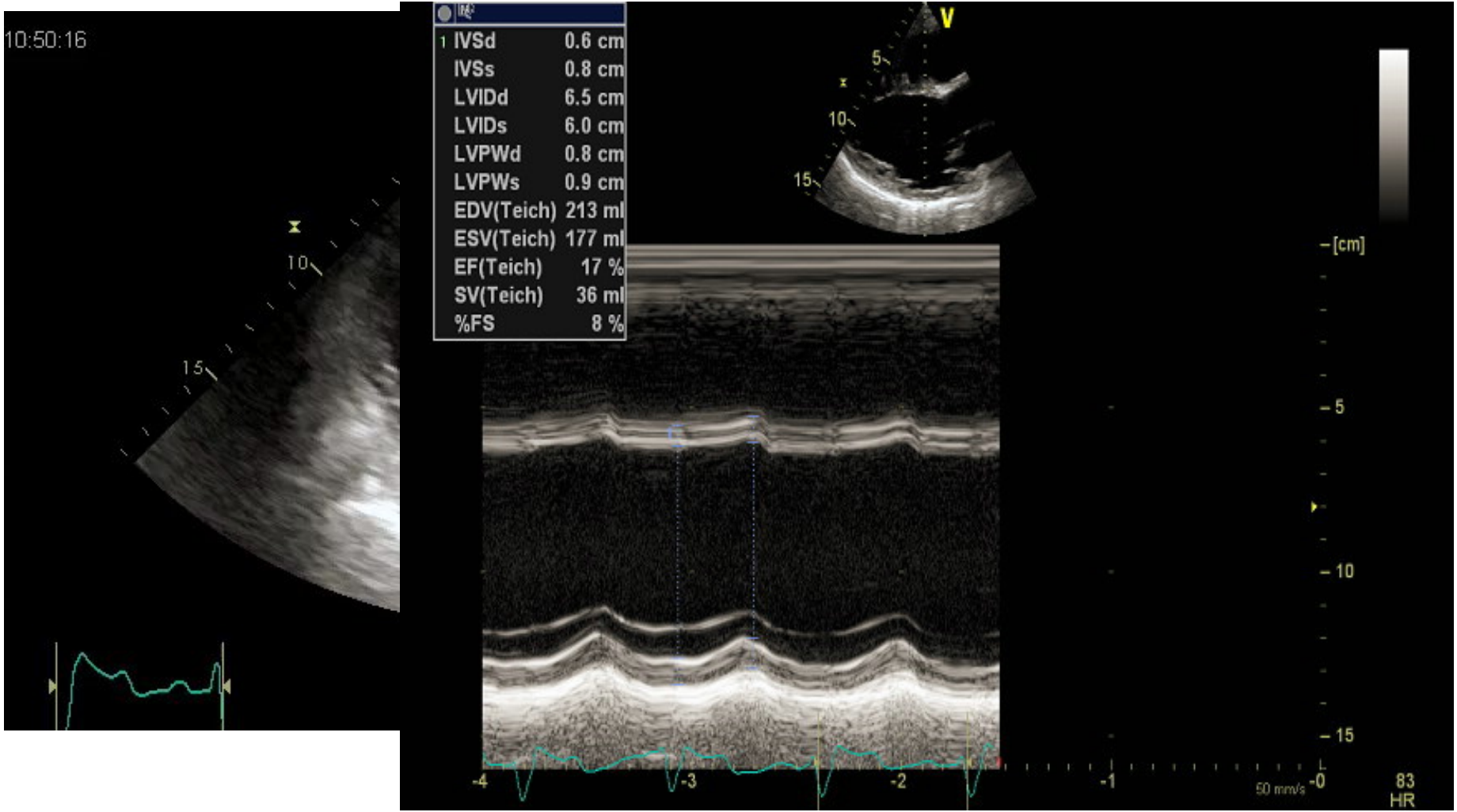
S-ICD should be strongly considered
Young patients
Life expectancy >10 y
Primary prevention indicated patients with ischemic/nonischemic heart failure
Prosthetic valves
Women (preferred generator placement lateral wall)
Selected secondary prevention indicated patients (survivors of out-of-hospital VF, no evidence of monomorphic VT
S-ICD should be avoided
Systolic heart failure and LBBB who are indicated for CRT
Symptomatic bradycardia requiring pacemaker
Recurrent sustained monomorphic VT for whom ATP is deemed appropriate

siol. 2013

A. L. 27 yrs

Diagnosis of TGA + VSD+ PS

- Aged 9 mths: Blalock-Hanlon atrial septectomy
- Aged 3 yrs: Rastelli procedure
- Aged 16 yrs: RV-PA conduit replacement
- Aged 21yrs: Diagnosis of early conduit stenosis
- Aged 25 yrs: Bicameral Pacemaker implant
- Aged 26yrs: Repeated hosp.admission for CHF.
  LV EF:10%
- Aged 27 yrs: in the waiting list for HTx.
  ECG 24h Holter: repeated n.s. VT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1 IVSd 0.6 cm
IVSs 0.8 cm
LVIDd 6.5 cm
LVIDs 6.0 cm
LVPWd 0.8 cm
LVPWs 0.9 cm
EDV(Teich) 213 ml
ESV(Teich) 177 ml
EF(Teich) 17 %
SV(Teich) 36 ml
%FS 8 %
V
5
10
15
[cm]
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15
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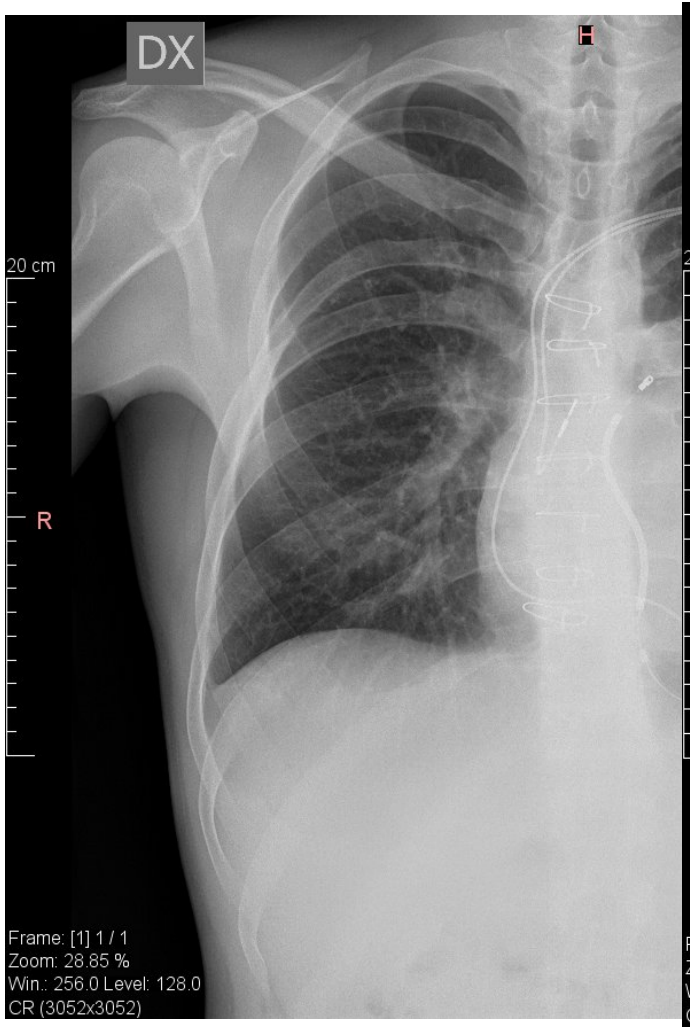
-1
-0
50 mm/s
83
HR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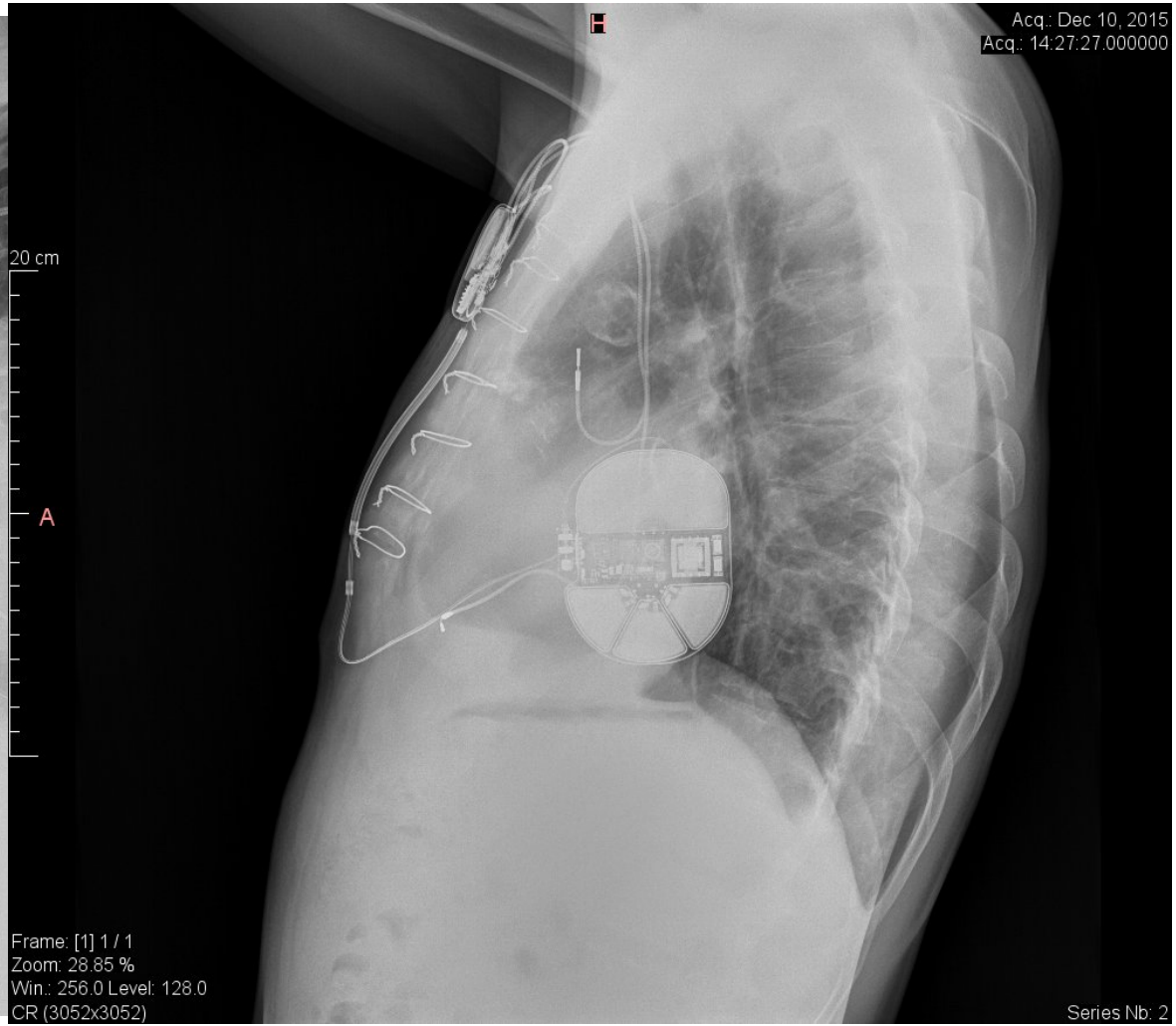
Zoom: 28.85 %
Win.: 256.0 Level: 128.0
CR (3052x3052)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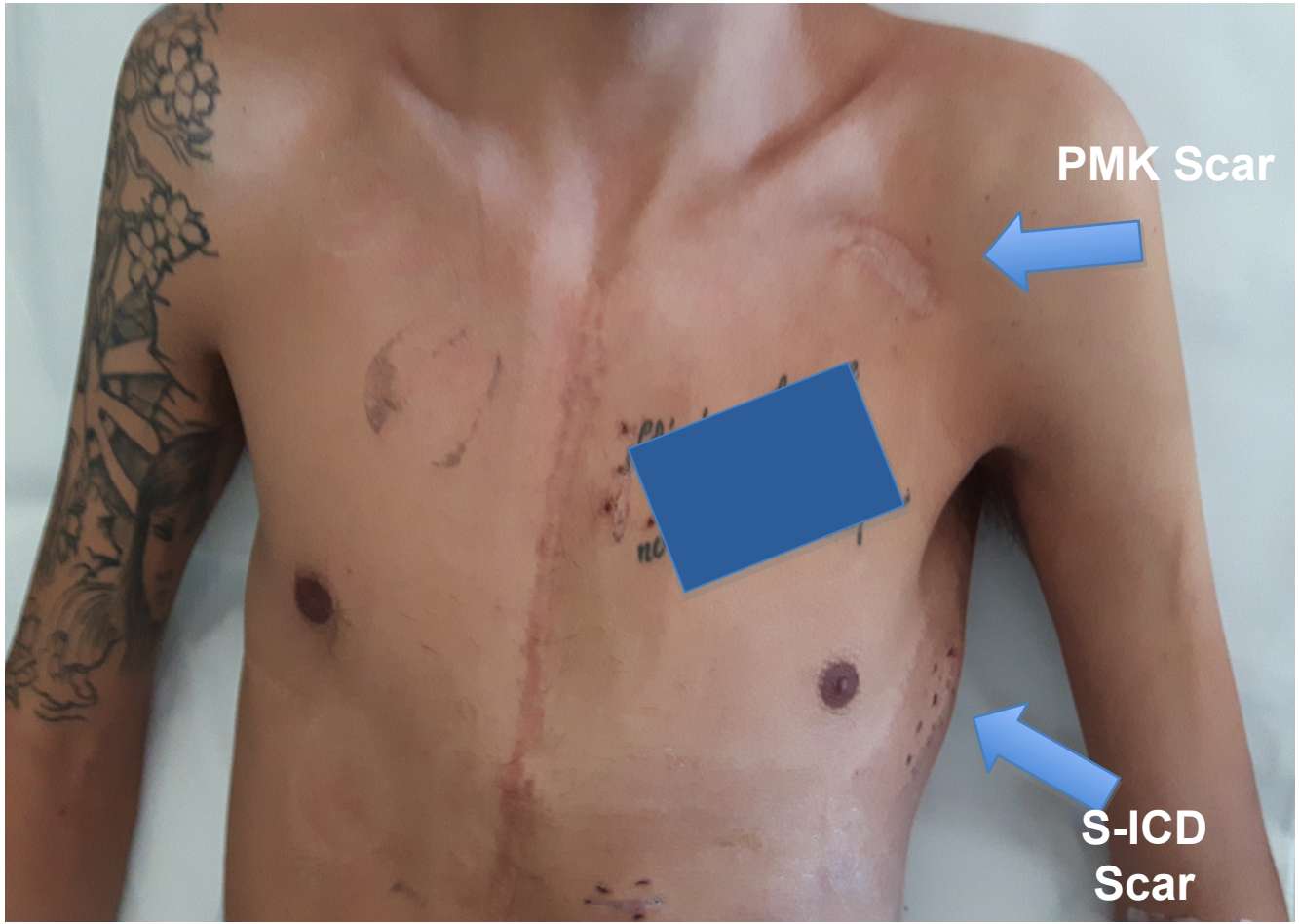
PMK Scar
S-ICD
Scar

Received: 8 August 2018 | Revised: 30 November 2018 | Accepted: 11 December 2018

DOI: 10.1002/joa3.12152

CASE REPORT

WILEY Journal of Arrhythmia Open Access

Combination of a leadless pacemaker and subcutaneous implantable cardioverter defibrillator therapy for a Japanese patient with prosthetic valve endocarditis

Ryo Ito MD[1] | Yusuke Kondo MD, PhD[2] | Joachim Winter MD, PhD[3] | Tomohiko Hayashi MD[1] | Miyo Nakano MD[1] | Takatsugu Kajiyama MD, PhD[1] | Masahiro Nakano MD, PhD[2] | Yoshio Kobayashi MD, PhD[1]

biventricular pacing met criteria compared to during RV pacing alone (80% vs. 46%, P <0.01). Patients that were paced from the RV septum were more likely to qualify compared to those paced from the RV apex (67% vs. 37%, respectively, P <0.01).

Conclusion: **While S-ICD implantation may be considered as supplemental therapy in select patients with preexisting transvenous devices, relatively fewer candidates who are paced from the RV apex qualify. QRS morphologies generated from biventricular pacing as well as from septal RV pacing are more likely to screen in based on the recommended S-ICD template.** *(J Cardiovasc Electrophysiol, Vol. 28, pp. 544-548, May 2017)*

EP CASE EXPRESS

doi:10.1093/europace/euaa028
Online publish-ahead-of-print 18 April 2020

Inappropriate shock due to quadruple counting in a patient with subcutaneous implantable cardioverter-defibrillator and a dual-chamber pacemaker

Halim Marzak*, Olivier Morel, and Laurence Jesel

Pôle d'activité médico-chirurgical cardio-vasculaire, Nouvel Hôpital Civil, CHU de Strasbourg, 1, place de l'Hôpital, F-67091 Strasbourg, France

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Adverse device-device interaction between pacemaker and subcutaneous implantable cardiac defibrillator

Nicholas Abbott MD[1] | Aron Bender MD[1] | Charles Henrikson MD[1] | Jared Miller MD[1] | Babak Nazer MD[1] | Seshadri Balaji MBBS, MRCP, PhD[2]

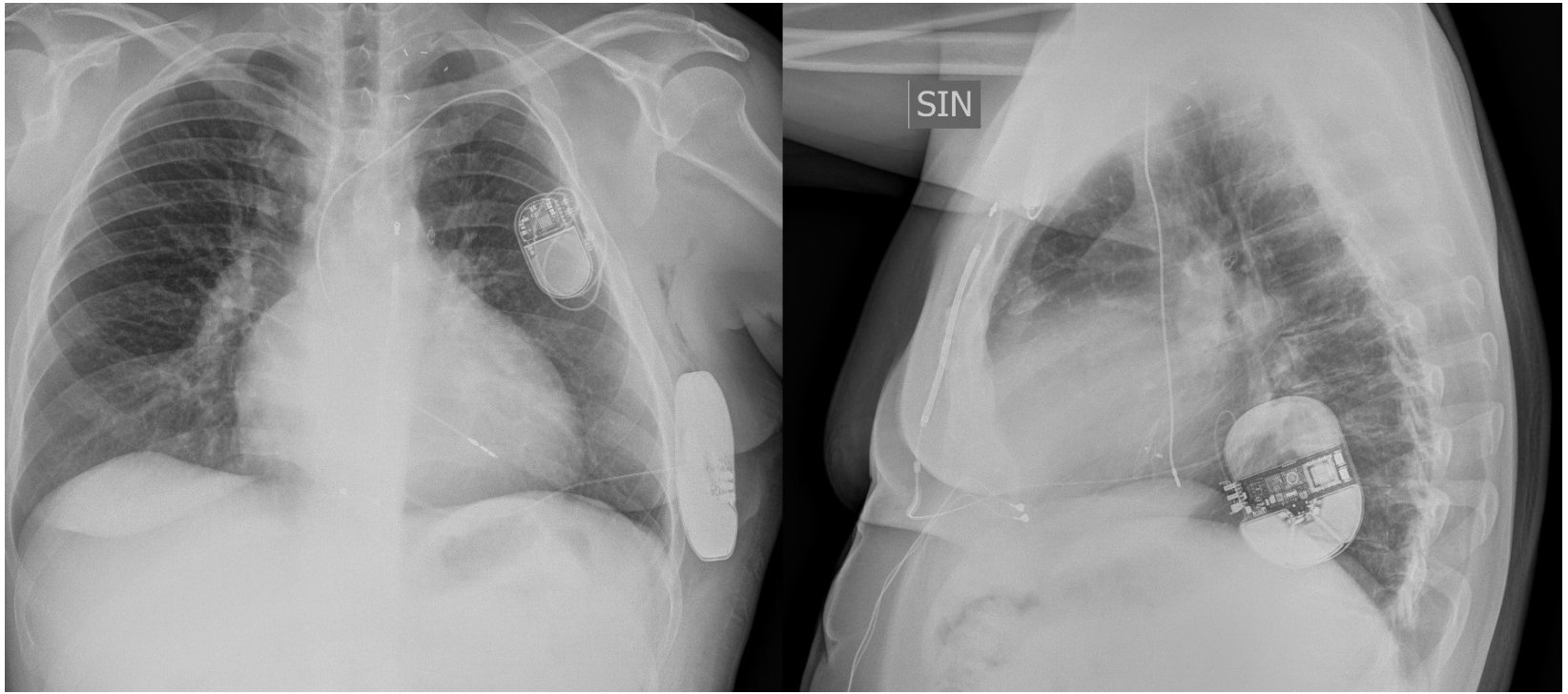
Adult Congenital Heart Disease Unit. Monaldi Hospital - Naples, Italy

Combined subcutaneous implantable cardioverter defibrillator and pacemaker devices in complex adult congenital heart disease.
A single-center experienced based study.

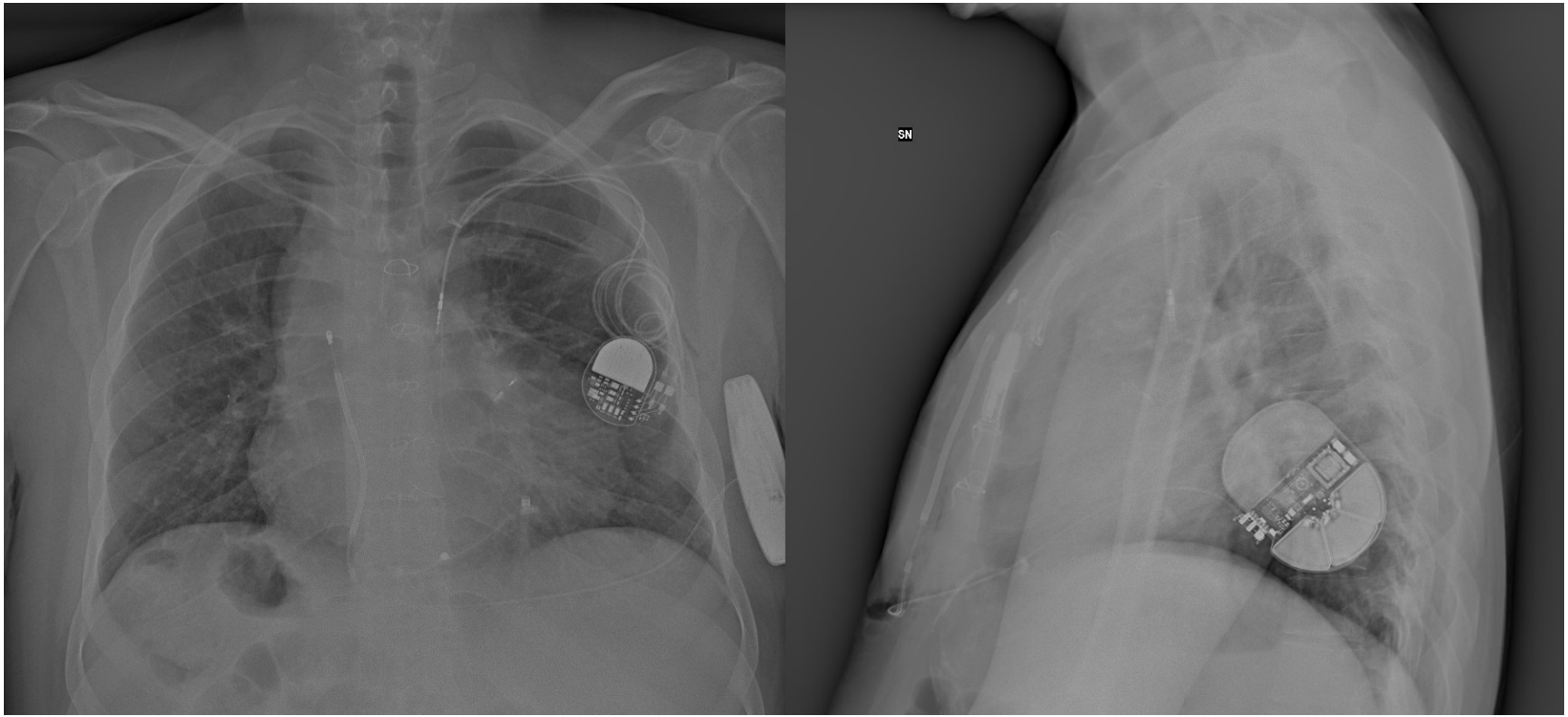
Sarubbi B et al. 2022

Unpublished data

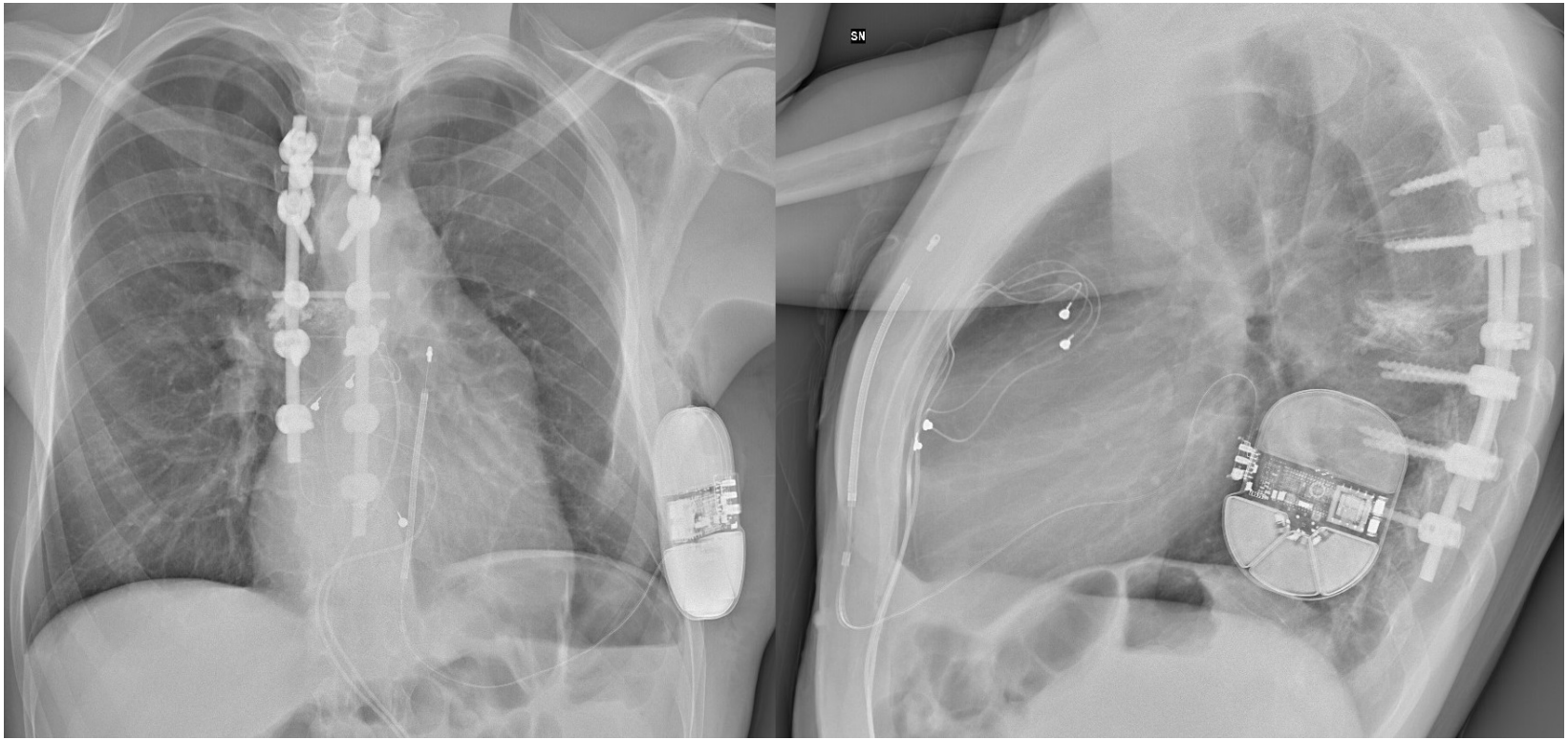
Pt.	Sex	Age	BSA (m^2)	Heart disease	Indication to PMK implant	Indication to S-ICD implant
#1	M	27	1.75	TGA + VSD + PS s/p Rastelli procedure	SND	1° prevention
#2	M	73	1.84	Mitral valve stenosis s/p MV replacement	AF with SVR	1° prevention
#3	M	41	2.07	TGA + VSD + PS s/p Senning procedure	III° AVB	1° prevention
#4	M	29	2.12	ccTGA + VSD + PS + situs inversus s/p VSD closure + pulmonary valve replacement	III° AVB	2° prevention (VT/VF storm)
#5	M	43	1.82	DILV + TGA s/p pulmonary banding	III° AVB	1° prevention
#6	M	18	2.01	ccTGA s/p tricuspid valve replacement	III° AVB	1° prevention
#7	F	13	1.38	TOF + LQTS type II s/p radical correction	Postop III° AVB	1° prevention
#8	M	61	2.35	Tricuspid valve endocarditis + atrial flutter s/p tricuspid valve replacement + Maze procedure	Postop III° AVB	1° prevention
#9	M	51	1.74	ccTGA	III° AVB	1° prevention
#10	M	35	1.94	TGA s/p Mustard + SVC baffle stenting	SND	1° prevention



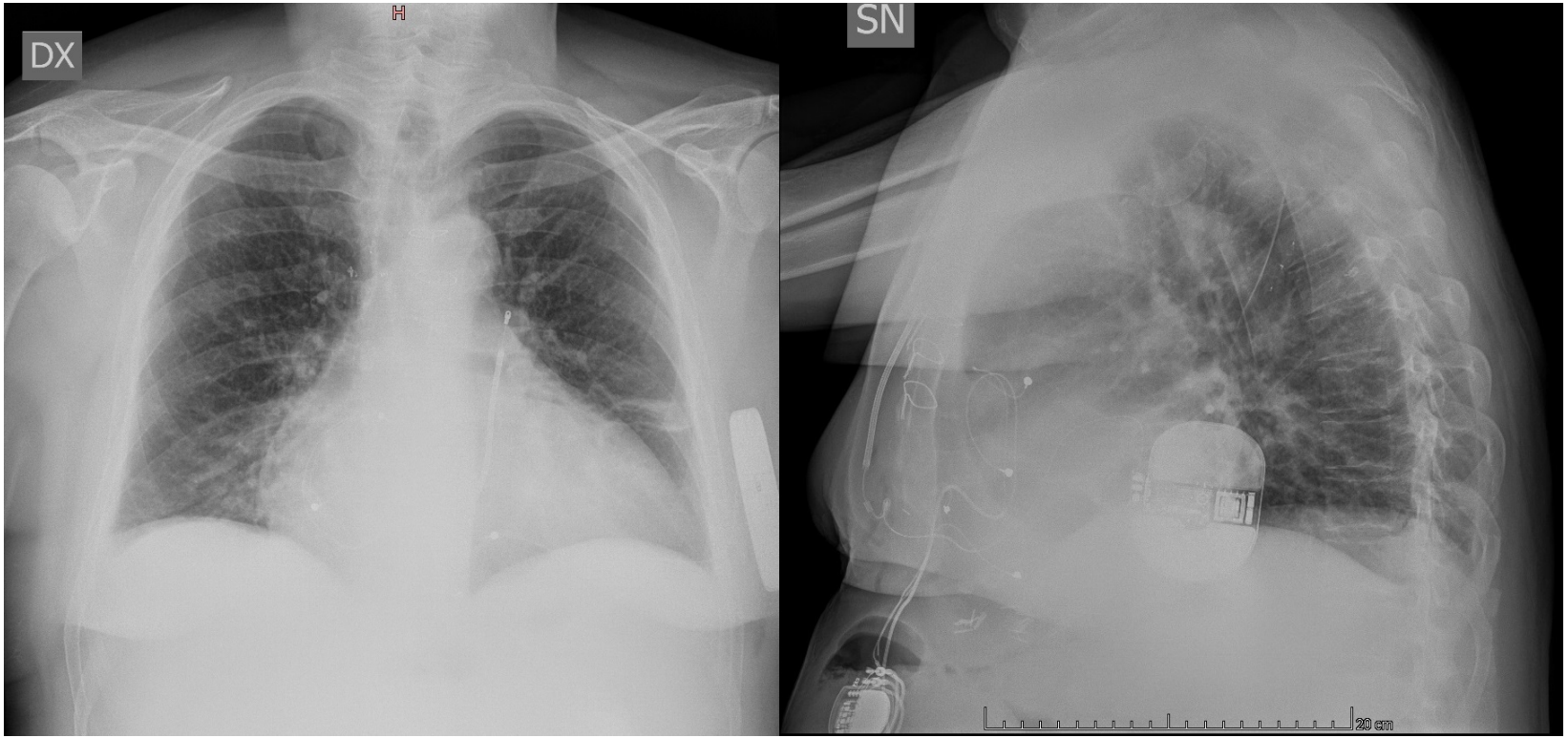
TGA + VSD + PS s/p Senning procedure



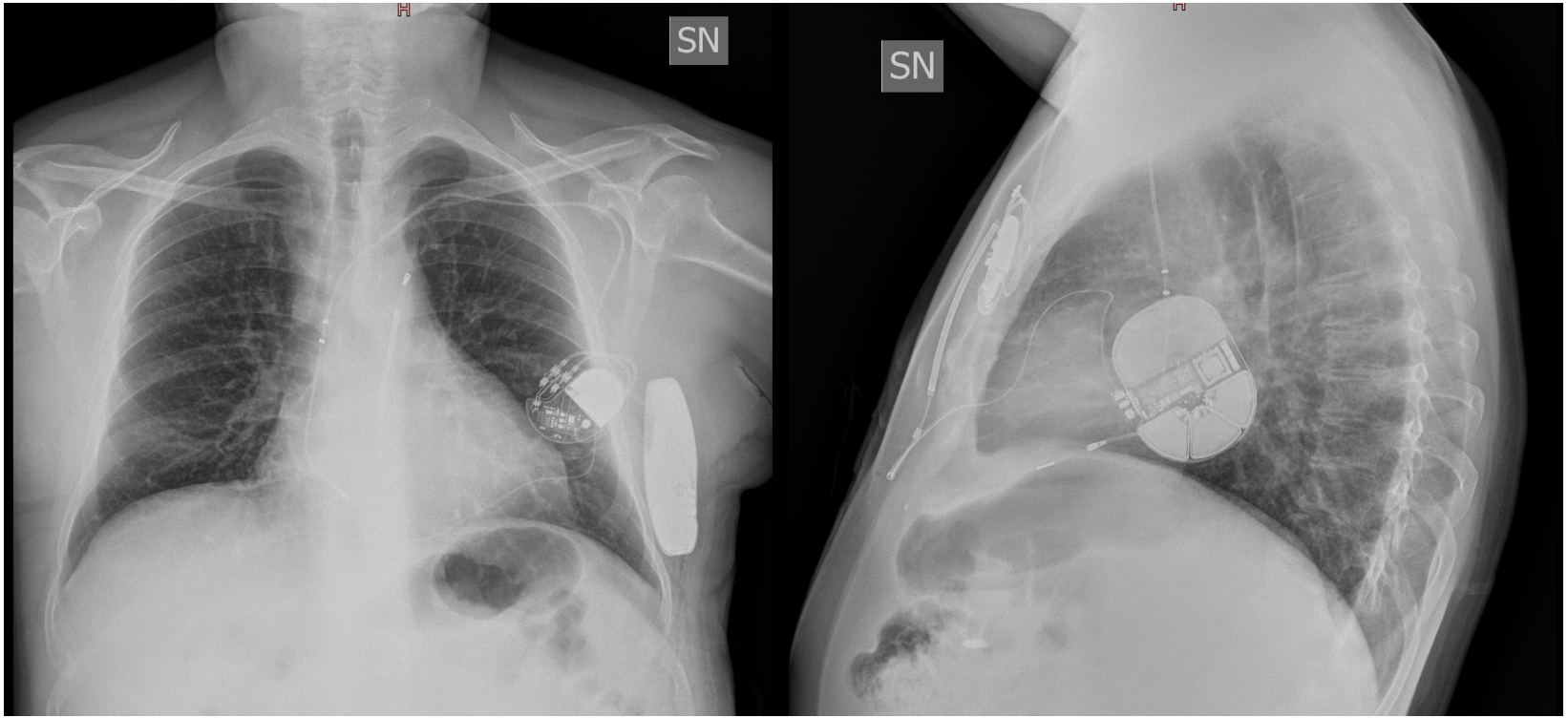
ccTGA + VSD + PS + situs inversus s/p VSD closure + pulmonary valve replacement



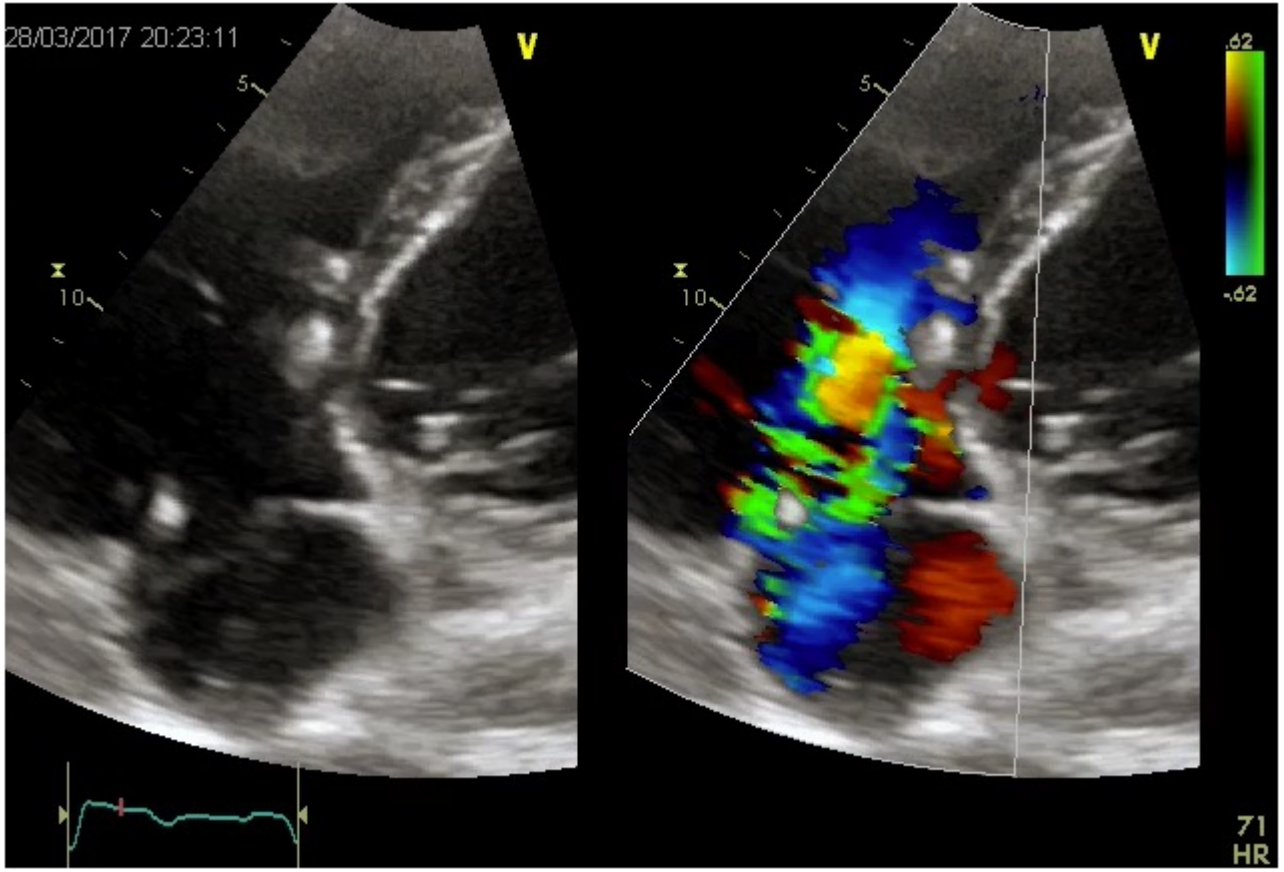
DILV + malposition of great arteries s/p pulmonary banding



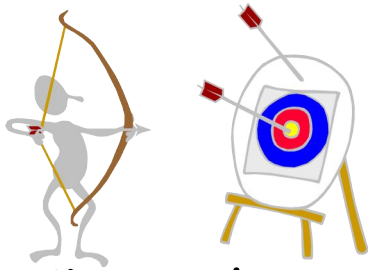
Tricuspid valve endocarditis + atrial flutter s/p tricuspid valve replacement + Maze procedure



ccTGA



F.R. 34 yrs
Valvular and subvalvular Stenosis s/p Surgery



Issues for the use of PMK and SICD in ACHD

SICD in the presence of unipolar pacing has been relatively contraindicated.

- ✓Artefacts from unipolar pacing could interfere with appropriate detection of VT/VF by the S-ICD
- ✓Risk of the S-ICD under-sensing true VF due to inappropriate pacing
- ✓Inappropriate shock from double counting
- ✓Test SICD during ventricular pacing with maximal output

Take-home message
PMK and SICD in ACHD

- S-ICD can be used safely in ACHD with a permanent PMK.
- There are important issues with regards to testing and programming that need to be addressed at the time of implantation.
- Patients should undergo the same screening as non-paced patients.
- Interference between the devices should be evaluated.
- Pacing spikes could be counted independently from the R waves by the S-ICD.
- Post-shock pacing from the S-ICD could inhibit pacing from the pacemaker and should be turned off.

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CLINICAL RE RCH

The Italian subcutaneous im cardioverter-defibrill why not?

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S-ICD in ACHD with a PMK, why not ?

Take-home message
PMK and SICD in ACHD

- For PMK-dependent patients, the conditional zone for SVT discrimination is not necessary.
- For pts who have tachy-brady synd., screening should be done during pacing and native rhythm and both should pass in at least 1 vector.
- Some PMKs have safety features that convert pacing to unipolar in the event of abnormal lead impedance or reversion to a back-up safety mode. This should be turned off, if possible, or the device tested with the leads programmed to unipolar pacing.