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2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death – Web Addenda

Task Force for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death of the European Society of Cardiology (ESC)

Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC)

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The disclosure forms of all experts involved in the development of these guidelines are available on the ESC website http://www.escardio.org/guidelines

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Web addenda

Web Table 1 Guidelines published since 2006 on the prevention of SCD in the general population, excluding those on specific diseases

Guidelines	Year	Ref.
ESC/EHRA Guidelines for cardiac pacing and CRT.	2007	4
ACC/AHA/HRS/AATS/STS Guidelines for device-based therapy of cardiac rhythm abnormalities.	2008	5
AHA/ACCF/HRS Scientific statement on non-invasive risk stratification techniques for identifying patients at risk for SCD.	2008	6
ESC/HFA/EHRA Focused Update of ESC Guidelines on device therapy in heart failure: an update of the 2008 ESC Guidelines for the diagnosis and treatment of acute and chronic HF and the 2007 ESC Guidelines for cardiac and resynchronization therapy.	2010	7
ESC/HFA Guidelines for the diagnosis and treatment of acute and chronic HF.	2012	8
ACCF/AHA Guideline for the management of HF.	2013	9
ESC/EHRA Guidelines on cardiac pacing and CRT.	2013	10
ACCF/AHA/HRS Focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities.	2013	11
HRS/ACC/AHA Expert consensus statement on the use of implantable cardioverter-defibrillator therapy in patients who are not included or not well represented in clinical trials.	2014	12
2014 ESC/EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS).	2014	13
EHRA/HRS/APHRS expert consensus on ventricular arrhythmias.	2014	3

AAC = American College of Cardiology; AATS = American Association for Thoracic Surgery; ACCF = American College of Cardiology Foundation; AHA = American Heart Association; CRT = cardiac resynchronization therapy; EACTS = European Association for Cardio-Thoracic Surgery; EHRA = European Heart Rhythm Association; ESC = European Society of Cardiology; HF = heart failure; HFA = Heart Failure Association; HRS = Heart Rhythm Society; SCD = sudden cardiac death; STS = Society of Thoracic Surgeons.

Web Table 2 Prevalence on autopsy series in young individuals (<40 years) of underlying inherited cardiomyopathies or sudden arrhythmic death syndrome, divided by athletes vs. the general population

Reference (year)	Country	Period	Age range (Years)	SCD (n)	HCM (%)	DCM (%)	ARVC (%)	Total CM (%)	SADS (%)
Athlete population									
Van Camp (1995)[25]	USA	1983–1993	13–24	105	45	5	1	51	7
Corrado (2003)[26]	Italy	1979–1999	12–35	52	2	2	23	27	2
Maron (2009)[27]	USA	1980–2006	8–39	690	36.3	2	4.3	42.6	–
Choi (2013)[28]	USA	2007–2008	11–30	54	30	4	–	34	7
Suàrez-Mier (2013)[29]	Spain	1995–2010	9–35	81	9.8	–	14.8	24.6	23.4
Maron (2014)[30]	USA	2002–2011	18–22	64	33	3	4.6	40.6	–
General population									
Topaz (1985)[31]	USA	1960–1983	7–35	50	12	–	–	12	14
Drory (1991)[32]	Israel	1976–1985	9–39	137	11	3	–	14	14
Wisten (2002)[33]	Sweden	1992–1999	15–35	181	10.5	12.2	6.6	29.3	21
Corrado (2003)[26]	Italy	1979–1999	12–35	277	8.5	4	13.5	26	7
Eckart (2004)[34]	USA	1977–2001	18–35	108	7	1	1	9	40
Puranik (2005)[35]	Australia	1995–2004	5–35	241	5.8	5.4	1.6	12.8	26.5
di Gioia (2006)[36]	Italy	2001–2005	2–40	100	4	4	12	20	19
Papadakis (2009)[37]	UK	2002–2005	1–34	1677	5	12	–	17	14
Morris (2009)[38]	Ireland	2005	0-35	69	14.5	1.5	1.5	17.5	40.6
Lim (2010)[39]	Canada	2005–2007	0–35	100	8	1	4	13	35
Winkel (2011)[40]	Denmark	2000–2006	1–35	314	0.6	1.3	5	7	43
Eckart (2011)[21]	USA	1998–2008	18–35	298	12.8	4.7	1.3	18.8	41
Margey (2011)[41]	Ireland	2005–2007	15–35	116	14.7	2.6	1.7	19	27
Pilmer (2013)[42]	Canada	2008	2–40	174	7	14	1.7	22.7	28
De Noronha (2014)[43]	UK	2007–2009	1-35	422	5	2	3	10	54
Risgaard (2014)[44]	Denmark	2007–2009	1–35	117	4.3	–	7.7	12	47.9
Winkel (2014)[45]	Denmark	2000–2006	1–18	62	1.6	1.6	6.5	9.7	40.3
Pilmer (2014)[46]	Canada	2005–2009	1–19	116	7	2	8	17	52
Vassalini (2015)[47]	Italy	1993–2012	1–40	54	9.2	–	11.1	20.3	22.2

ARVC = arrhythmogenic right ventricular cardiomyopathy; CM = cardiomyopathy; DCM = dilated cardiomyopathy; HCM = hypertrophic cardiomyopathy; SADS = sudden arrhythmic death syndrome (i.e. normal heart); SCD = sudden cardiac death. Adapted from Mazzanti *et al.*[48]

Web Table 3 **Common definitions used when describing ventricular arrhythmias**[122]

Terminology - Type of VA	Definition - ECG classification
Bidirectional VT	VT with a beat-to-beat change in the QRS axis.
Bundle-branch re-entrant tachycardia	VT due to re-entry involving the His-Purkinje system, usually with LBBB morphology; most common in DCM with prolonged HV interval.
Idioventricular rhythm	Arrhythmia of three or more consecutive complexes originating from ventricles at a rate of <100 bpm.
Monomorphic VT	Stable single QRS morphology during VT.
Non-sustained VT	Three or more consecutive ventricular complexes in duration, terminating spontaneously in <30 seconds.
Pleomorphic VT	More than one stable QRS morphology during an episode of VT.
Polymorphic VT	A changing or multiform QRS morphology at cycle length between 100 and 300 bpm during VT.
Premature ventricular complexes	A ventricular depolarization that occurs earlier than expected and appears on the ECG as an early, wide QRS complex without a preceding related P wave.
Sustained VT	VT ≥30 seconds in duration and/or requiring termination due to haemodynamic compromise in <30 seconds.
Torsade de pointes	VT characterized by twisting of the QRS complexes around the isoelectric line on the ECG during the arrhythmia, which may be associated with a Long QT Syndrome.
Ventricular flutter	A regular (cycle length variability ≤30 ms) VT approximately 300 bpm with a monomorphic appearance; no isoelectric interval between successive QRS complexes.
Ventricular fibrillation	Rapid, usually >300 bpm (cycle length ≤200 ms), grossly irregular ventricular rhythm with marked variability in QRS cycle length, morphology, and amplitude.
Ventricular tachycardia	Arrhythmia of three or more consecutive complexes in duration originating from the ventricles at a rate of ≥100 bpm.

bpm = beats per minute; DCM = dilated cardiomyopathy; ECG = electrocardiogram; LBBB = left bundle branch block; VA = ventricular arrhythmia; VT = ventricular tachycardia; ms = milliseconds.

Web Table 4 **Investigations that may disclose disease specific findings**

Disease states and investigations that would disclose disease specific findings	Clinical History, familial cluster of SCD	ECG	Holter, event recorder, implantable loop recorder	Exercise test	SAEG	Imaging
Long QT Syndrome Short QT Syndrome	Events during provocative situations, familial	Long QTc, Short QTc	Long QT, TdP Short QT, TdP, AF	–	–	–
Brugada syndrome	Fever induced VT, familial	ST elevation ≥2 mm with a coved aspect in V1 and/or V2 positioned in 2nd, 3rd or 4th intercostal space	–	–	–	–
Catecholaminergic Polymorphic Ventricular Tachycardia	Exercise induced syncope, familial	–	VT at exercise	VT at exercise	–	–
Arrhythmogenic Right Ventricular Cardiomyopathy	familial	Negative T waves in V1–V3	–	–	Late potentials	RV morphological changes, increased dimension
Hypertrophic Cardiomyopathy	familial	LV hyper-trophy	–	–	–	LV hypertrophy Scarring
Coronary artery disease	Chest pain	Q waves, ST changes, LBBB	–	Exercise induced ST changes	–	Dyskinesia post MI
Dilated Cardiomyopathy	Dyspnoea	–	–	–	–	Systolic dysfunction – reduced LVEF

AF = atrial fibrillation; LBBB = left bundle branch block; LVEF = left ventricular ejection fraction; MI = Myocardial infarction; nsVT = nonsustained ventricular tachycardia; RV = right ventricular; LV = left ventricular; SAEG = signal-averaged electrocardiogram; TdP = Torsade de Pointes.

Web Table 5 **Meta-analysis of ICD secondary prevention trials (modified from Connolly et *al.*[154])**

Trial	*N*	Total mortality			Arrhythmic mortality		
		Events	Hazard ratio	95% CI	Events	Hazard ratio	95% CI
AVID[153]	1016	80	0.62	0.47–0.81	24	0.43	0.27–0.66
CIDS[151]	659	83	0.82	0.61–1.10	30	0.68	0.43–1.08
CASH[152]	191	37	0.83	0.52–1.33	7	0.32	0.15–0.69
Cumulative	1866	200	0.72	0.60–0.87	61	0.50	0.37–0.67

AVID = Antiarrhythmic drugs Versus Implantable Defibrillator; CASH = Cardiac Arrest Study Hamburg; CI = confidence interval; CIDS = Canadian Implantable Defibrillator Study. P value for heterogeneity = 0.306.

Web Table 6 **Subcutaneous implantable cardioverter defibrillator trials**

Lead author (year)	No. of patients (*n*)	Mean follow-up (months)	Appropriate detection (%)	Successful conversion with DFT (%)	Inappropriate shocks in follow-up (%)	Complications requiring re-intervention (%)
Bardy (2010)[159]	55	10	100	98	9	11
Dabiri Abkenari (2011)[161]	31	9	100	100	16	10
Olde Nordkamp (2012)[162]	118	18	NR	100	13	14
Aydin (2012)[163]	40	8	NR	97.5	5	13
Jarman (2012)[160]	16	9	100	100	25	19
Jarman (2013)[164]	111	12	100	100	15	16
Köbe (2013)[165]	69	7	NR	95.5	4	4
Weiss (2013)[157]	314	11	99.8	100	14	1.3
Lambiase (2014)[158]	472	18.5	NR	99.7	7	NR

DFT = defibrillation threshold; NR = not recorded.