Arrhythmia in heart failure

DEEPHAK SWAMINATH MD, MBA, FACHE, FACC, FHRS
DIRECTOR OF ELECTROPHYSIOLOGY
TEXASTECH UNIVERSITY HEALTH SCIENCE CENTER
LUBBOCK.

Arrhythmia in heart failure

- Atrial Fibrillation
- Atrial Flutter
- Ventricular Arrhythmia –NSVT, PVC and VT

Atrial Fibrillation and Heart Failure

Atrial Fibrillation and Heart Failure

- AF is also associated with significant morbidity and mortality, due primarily to the increased risk of thromboembolic events and adverse hemodynamic effects that may result.
- AF is one of the strongest predictors for the development of heart failure.
- In the Framingham Heart Study, the development of AF was responsible for worsening heart failure symptoms and was seen as the second greatest reason for hospitalization, second to acute heart failure exacerbation

Benjamin EJ, Levy D, Vaziri SM, et al. Independent risk factors for atrial fibrillation in a population-based cohort: the Framingham Heart Study. JAMA. 1994;271(11):840–844.

Thrall G, Lane D, Carroll D, et al. Quality of life in patients with atrial fibrillation: a systematic review. Am J Med. 2006;119(5):448:e1–448:e19.

Background Incidence of CHF in atrial fibrillation population

- One in four of the AF patients in this study developed CHF during follow-up and that the lifetime risk of AF in the Framingham Heart cohort was also one in four
  - In the Framingham Heart Study, 2326 men and 2866 women were fol- lowed for 2 years, and the risk of developing permanent AF was 8.5% for men and 13.7% for women.
  - In those without prior or concurrent congestive heart failure or myocardial infarction, the lifetime risks for AF were approximately 16%.
  - Diastolic heart failure, approximately 25% to 30% of patients have evidence of AF. The prevalence increases with the severity of diastolic heart failure, reaching up to 40% in advanced stages.

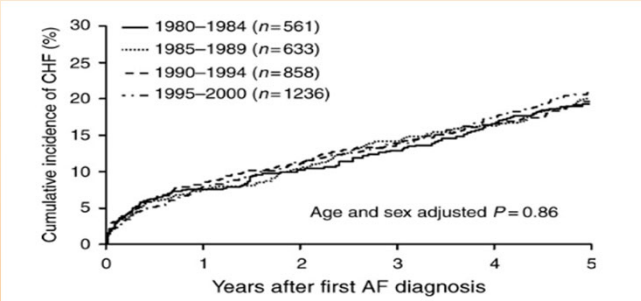
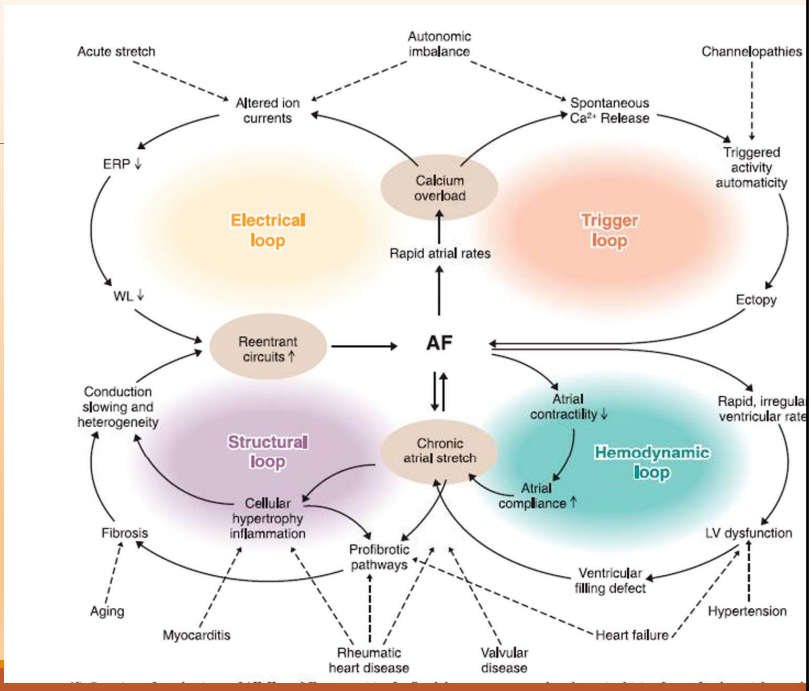


Figure 2 Time trends for cumulative incidence of first CHF following first AF.

Pathophysiology of Atrial Fibrillation

In Heart Failure

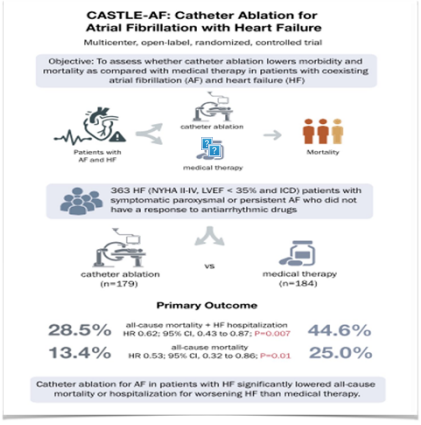
- Loss of atrial systole
- Increased Heart rate
- Thromboembolic Complication



Guidelines

Heart failure			
A beta blocker or nondihydropyridine calcium channel antagonist is recommended for persistent or permanent AF in patients with HF*p*EF	I	B	(269)
In the absence of preexcitation, an IV beta blocker (or a nondihydropyridine calcium channel antagonist with HF*p*EF) is recommended to slow ventricular response to AF in the acute setting, with caution in patients with overt congestion, hypotension, or HF*r*EF	I	B	(502-505)
In the absence of pre-excitation, IV digoxin or amiodarone is recommended to control heart rate acutely	I	B	(277,503,506,507)
Assess heart rate during exercise and adjust pharmacological treatment in symptomatic patients during activity	I	C	N/A
Digoxin is effective to control resting heart rate with HF*r*EF	I	C	N/A
A combination of digoxin and beta blocker (or a nondihydropyridine calcium channel antagonist with HF*p*EF) is reasonable to control resting and exercise heart rate with AF	IIa	B	(267,503)
It is reasonable to perform AV node ablation with ventricular pacing to control heart rate when pharmacological therapy is insufficient or not tolerated	IIa	B	(269,508,509)
IV amiodarone can be useful to control heart rate with AF when other measures are unsuccessful or contraindicated	IIa	C	N/A
With AF and RVR causing or suspected of causing tachycardia-induced cardiomyopathy, it is reasonable to achieve rate control by AV nodal blockade or a rhythm-control strategy	IIa	B	(51,307,510)
In patients with chronic HF who remain symptomatic from AF despite a rate-control strategy, it is reasonable to use a rhythm-control strategy	IIa	C	N/A
Amiodarone may be considered when resting and exercise heart rate cannot be controlled with a beta blocker (or a nondihydropyridine calcium channel antagonist with HF*p*EF) or digoxin, alone or in combination	IIb	C	N/A
AV node ablation may be considered when rate cannot be controlled and tachycardia-mediated cardiomyopathy is suspected	IIb	C	N/A

Rhythm Control Vs Rate Control Strategy in Heart Failure

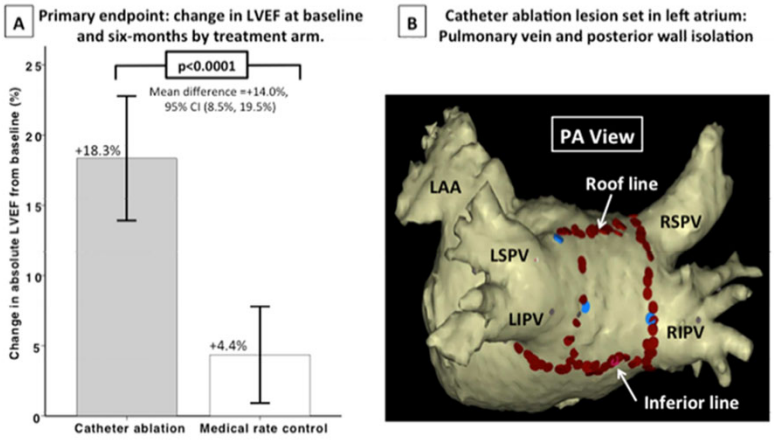


Article

Catheter Ablation Versus Medical Rate control in Atrial Fibrillation and Systolic Dysfunction (CAMERA-MRI)

TheBakerHeart&DiabetesInstitute,Melbourne,Australia; TheAlfredHospital, Melbourne, Australia; Monash Heart, Melbourne, Australia; Royal Melbourne Hospital, Melbourne, Australia; University of Melbourne, Melbourne, Australia; Monash University, Melbourne, Australia.

Outcome



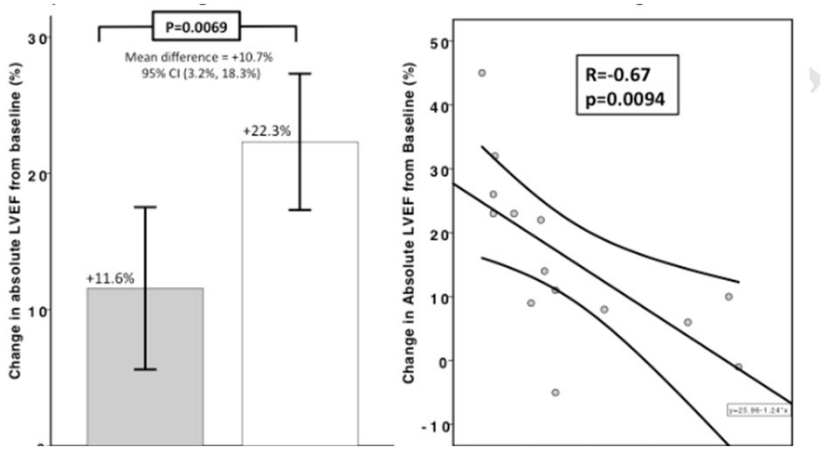
Results

Primary and secondary endpoints	Catheter ablation (n=33)		Medical rate control (n=33)		Comparison between treatment arms	
	Baseline	6 months	Baseline	6 months	Mean Difference	P value*
Primary endpoint						
LVEF (MRI) (%)	31.8 ± 9.4	50.1 ± 11[$]	34.1 ± 7.8	38.5 ± 8.7[‡]	+14.0 (8.5, 19.5)	**<0.0001**
Secondary endpoints						
LVEF (echocardiography) (%)	35.0 ± 9.8	52.7 ± 11.9[$]	34.8 ± 43.7	43.7 ± 12.7[‡]	+7.5 (+1.6, +13.5)	**0.0137**
LV end systolic volume (ml/m^2)	79.5 ± 33.3	55.3 ± 30.5[$]	76.3 ± 27.2	68.2 ± 26.3[†]	-16.1 (-27.7, -4.5)	**0.0075**
LV end diastolic volume (ml/m^2)	114 ± 40	106 ± 33[†]	113 ± 32	109 ± 39	-2.1 (-14.5, +10.4)	0.74
LA volume (ml/m^2)	54.4 ± 16.1	43.4 ± 13.3[$]	53.9 ± 18.9	55.6 ± 14.6	-13.4 (-20.4, -6.5)	**0.0003**
LV stroke volume (ml/m^2)	34.9 ± 12.7	50.5 ± 10.1[$]	38.6 ± 12.5	40.5 ± 14.8	-16.1 (-27.7, -4.45)	**<0.0001**
Average NYHA Class	2.55 ± 0.62	1.33 ± 0.48[$]	2.45 ± 0.56	2.06 ± 0.50[‡]	-0.82 (-1.13, -0.51)	**<0.0001**
BNP (log[ng/L])	2.34 ± 0.38	1.84 ± 0.37[$]	2.27± 0.43	2.14 ± 0.56	-0.38 (-0.65, -0.11)	**0.0063**
BNP (ng/L)[ll]	266 ± 210	98 ± 77	256 ± 208	247 ± 197		**0.0131**
6 minute walk test distance (m)	491 ± 147	546 ± 82[†]	489 ± 132	518 ± 119[†]	+27 (-28, +79)	0.34
SF-36 Physical component scores	41.6 ± 11.6	48.5 ± 8.2[$]	38.8 ± 10.4	44.6 ± 11.2[‡]	1.3 (-3.9, +6.5)	0.62
SF-36 Mental component scores	49.1 ± 10.6	53.3 ± 7.7[‡]	50.3 ± 11.2	52.9 ± 8.9	1.6 (-3.1, +6.3)	0.49

Results

Comparison within each group (LGE positive vs LGE negative)				
Patients undergoing catheter ablation (n=36)	**LGE positive (n=14)**	**LGE negative (n=22)**	**Mean difference**	**P value**
Baseline LVEF	32.1 ± 8.7%	31.7 ± 9.4%	0.4% (-5.9,%, 6.8%)	0.89
6 month LVEF	43.7 ± 11.2%	54.0 ± 8.5%	+10.3% (3.3%, 17.0%)	**0.0036**
Change in LVEF from baseline	+11.6 ± 10.3%	+22.3 ± 11.3%	+10.7% (3.2%, 18.3%)	**0.0069**
LVEF ≥50% at 6 months (%)	29% (4)	73% (16)	44.2% (10.7%, 66.1%)	**0.0093**
Improvement in LVEF by ≥15%	29% (4)	82% (18)	53.2% (20.2%, 73.3%)	**0.0014**
Patients undergoing medical rate control (n=30)	**LGE positive (n=10)**	**LGE negative (n=20)**	**Mean difference**	**P value**
Baseline LVEF	29.0 ± 7.8%	36.8 ± 7.0 %	7.7% (2.1%, 13.3%)	**0.0089**
6 month LVEF	33.8 ± 7.3%	39.3 ± 9.8%	5.5% (-1.0%, 12.0%)	0.09
Change in LVEF from baseline	+4.8 ± 8.5%	+2.9 ± 9.8%	2.3% (-5.1%, 9.7%)	0.54
LVEF ≥50% at 6 months (%)	0% (0)	10% (2)	10% (-25%, 33%)	0.30
Improvement in LVEF by ≥15%	0% (0)	10% (2)	10% (-25%, 33%)	0.30
Comparison between treatment arms (catheter ablation and medical rate control)				
LGE positive	**Mean difference**	**95% CI**		**P value**
Change in LVEF from baseline	+6.8%	-1.5%, 15.0%		0.10
LVEF ≥50% at 6 months (%)	29%	-3.9%, 54.7%		0.06
LGE negative	**Mean difference**	**95% CI**		**P value**
Change in LVEF from baseline	+19.8%	13.1%, 26.4%		**<0.0001**
LVEF ≥50% at 6 months (%)	63%	30.0%, 80.4%		**<0.0001**

Results

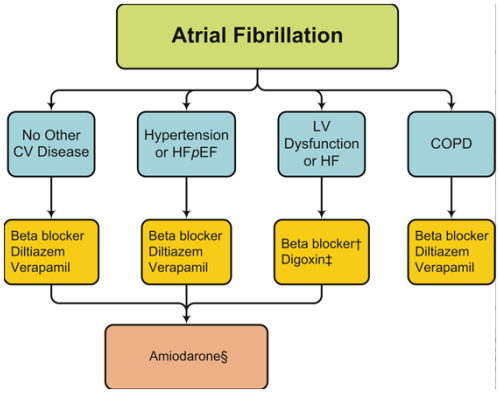


Focused Update of the AHA/ACC/HRS Atrial Fibrillation Guideline Jan 2019

AF catheter **ablation may be reasonable in symptomatic patients with heart failure** and a reduced ejection fraction to reduce mortality and heart failure hospitalizations (COR IIb, B-R).

Weight loss combined with risk factor modification is recommended for overweight and obese patients with AF (COR I, LOE B-R).

Medical management of Afib with Heart failure

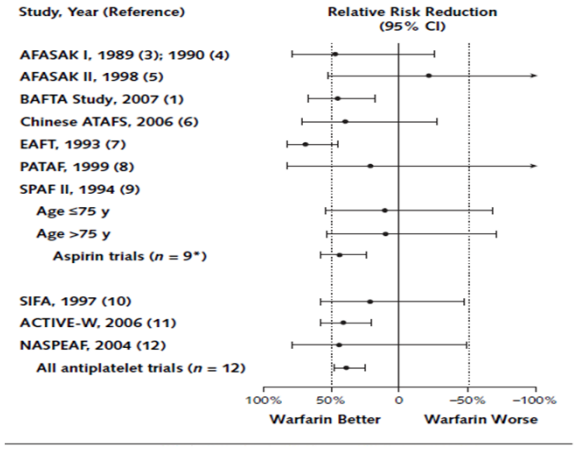


Atrial Fibrillation as an Independent Risk Factor for Stroke: The Framingham Study

Philip A. Wolf, MD; Robert D. Abbott, PhD; and William B. Kannel, MD

The impact of nonrheumatic atrial fibrillation, hypertension, coronary heart disease, and cardiac failure on stroke incidence was examined in 5,070 participants in the Framingham Study after 34 years of follow-up. Compared with subjects free of these conditions, the age-adjusted incidence of stroke was more than doubled in the presence of coronary heart disease ($p<0.001$) and more than trebled in the presence of hypertension ($p<0.001$). There was a more than fourfold excess of stroke in subjects with cardiac failure ($p<0.001$) and a near fivefold excess when atrial fibrillation was present ($p<0.001$). In persons with coronary heart disease or cardiac failure, atrial fibrillation doubled the stroke risk in men and trebled the risk in women. With increasing age the effects of hypertension, coronary heart disease, and cardiac failure on the risk of stroke became progressively weaker ($p<0.05$). Advancing age, however, did not reduce the significant impact of atrial fibrillation. For persons aged 80–89 years, atrial fibrillation was the sole cardiovascular condition to exert an independent effect on stroke incidence ($p<0.001$). The attributable risk of stroke for all cardiovascular contributors decreased with age except for atrial fibrillation, for which the attributable risk increased significantly ($p<0.01$), rising from 1.5% for those aged 50–59 years to 23.5% for those aged 80–89 years. While these findings highlight the impact of each cardiovascular condition on the risk of stroke, the data suggest that the elderly are particularly vulnerable to stroke when atrial fibrillation is present. The powerful independent effect of atrial fibrillation reported here is in accord with the findings of recent randomized clinical trials in which >50% of stroke events were prevented by warfarin anticoagulation. (*Stroke* 1991;22:983–988)

Warfarin in stroke prevention



All cause mortality reduced to 26%

Hart et al Ann Intern Med 2007

NOAC

Dabigatran

Rivaroxaban

Apixaban

Edoxaban

NOAC vs Warfarin Trial

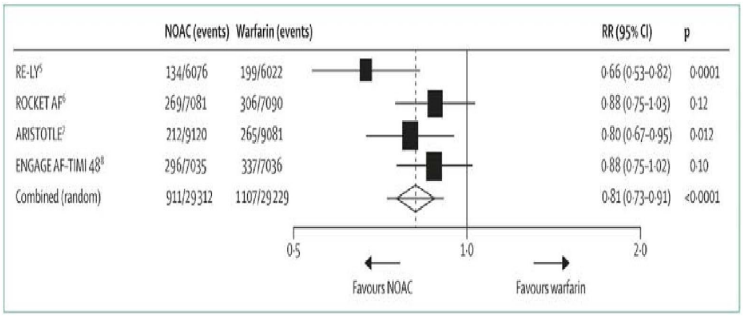
Major phase III trials for NOAC versus Warfarin in non-valvular atrial fibrillation.

	RE-LY Dabigatran[5, 7]	ARISTOTLE Apixaban[5, 6]	ROCKET AF Rivaroxaban[5, 8]	ENGAGE AF TIMI 48 Edoxaban[5, 9]
Drug mechanism	IIa inhibitor	Factor Xa inhibitor	Factor Xa inhibitor	Factor Xa inhibitor
Onset of action	2 h	1–2 h	2–4 h	1–2 h
Half-life	12–17 h	Approx. 12 h	6–13 h	10–14 h
Study population	N = 18,113	N = 18,201	N = 14,264	N = 21,105
Dosing	150 mg twice daily 110 mg twice daily	5 mg twice daily 2.5 mg twice daily if age > 80, weight < 60 kg, Creatinine >1.5 mg/dl	20 mg daily 15 mg daily if CrCl <50 ml / min	60 mg daily 30 mg daily if CrCl 30–50 ml / min, w use of P-glycoprotein inhibitors
Average $CHADS_2$	2.1	2.1	3.5	2.8
Stroke/SE reduction vs. VKAs	110 mg: Non-Inferior* 150 mg: Superior**	Superior**	Non-inferior*	30 mg: Non-inferior* 60 mg: Superior**

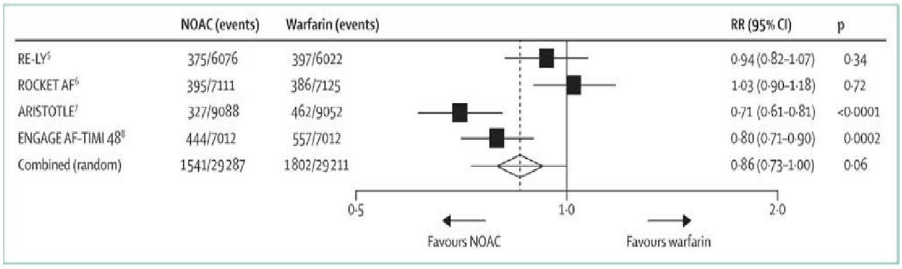
* **Non-inferiority** All comparisons p < .001 except Edoxaban 30 mg (p = .005).
** **Superiority** p < .001 for Dabigatran (150 mg); p = .01 for Apixaban; p = .02 for Edoxaban (60 mg).

- S.T. Chen, M.R.Patel / Progressin CardiovascularDiseases60 (2018) 514–523

Stroke or Systemic embolism



Major Bleeding



	Choice of NOACs	Considerations
Gastrointestinal Bleeding[6]	Apixaban Rivaroxaban	Only NOAC with smaller number of GI bleeds in the original studies. 150 mg dabigatran showed trend toward higher bleeding in the elderly.
Elderly[17–19]	Apixaban Edoxaban 110 mg dabigatran	
Impaired Renal Function[26–29]	Apixaban Rivaroxaban Edoxaban	Caution for edoxaban in patients with CrCl >95 ml/min; Dabigatran should be avoided due to high renal clearance
Coronary Artery Disease[33, 97]	Rivaroxaban	Only NOAC with a proven benefit after ACS.
Diabetes Mellitus[55]	Apixaban Dabigatran Edoxaban Rivaroxaban	No interaction between DM and efficacy and safety of NOACs
Cardioversion[86, 87]	Edoxaban Rivaroxaban	Both prospectively found to be viable alternatives to warfarin for cardioversion.
Mechanical Heart Valve[95]	None	NOACs have been associated with higher rates of thromboembolic and bleeding events
Bioprosthetic Valve[96]	More data needed	Comparable treatment effects between apixaban and VKAs in a small number of patients with bioprosthetic valves in ARISTOTLE.
Non-mechanical, Non-rheumatic valvular disease[93, 98]	Apixaban Edoxaban Dabigatran	Rivaroxaban was associated with higher rates of bleeding in those with native valvular disease.

Ventricular Arrhythmia in Heart Failure

Nonsustained Ventricular Tachycardia

- Nonsustained VT is commonly detected during ECG monitoring in heart failure patients with both ischemic and nonischemic cardiomyopathies.
- In 1997, the Amiodarone Trials Meta-analysis Investigators reviewed 13 randomized controlled trials comparing amiodarone to placebo in patients with either recent myocardial infractions or congestive heart failure. They estimated that prophylactic amiodarone would reduce arrhythmic/sudden death by 29% and total mortality by 13%.
- In the Sudden Cardiac Death-Heart Failure Trial (SCDHeFT), which was completed in 2004, empiric amiodarone had no advantage over a placebo in patients with NYHA class II symptoms and actually increased mortality in patients with class III symptoms.
- Asymptomatic ventricular ectopy should be considered a risk factor for future events and not as a target for therapy. However, in patients with very high frequency monomorphic premature ventricular contractions (PVCs) and VT, mapping and ablation of the site of origin may improve function and eliminate symptoms

Pharmacologic Therapy for Chronic Management of Ventricular Tachycardia

- Amiodarone and sotalol are the antiarrhythmic drugs most commonly used as adjuncts to ICD therapy in patients with structural heart disease and heart failure.
- Pacifico and associates randomized 302 patients with prior sustained arrhythmias and secondary prevention ICDs to either sotalol (160–320 mg daily) or a placebo. Sotalol resulted in a 48% reduction of the primary endpoint of death from any cause or delivery of first shock for any cause. Overall shock frequency was significantly reduced to 1.43 ± 3.53 shocks per year in the sotalol group from 3.89 ± 10.65 shocks per year in the placebo group.
- Optimal Pharmacological Therapy in Cardioverter Defibrillator Patients Trial (OPTIC), β-adrenergic blockade only, sotalol, and amiodarone plus β-blockade were compared. Sotalol and, to a greater degree, amiodarone plus β-blockade significantly decreased the frequency of shocks, both appropriate and inappropriate.

Pharmacologic Therapy for Chronic Management of Ventricular Tachycardia

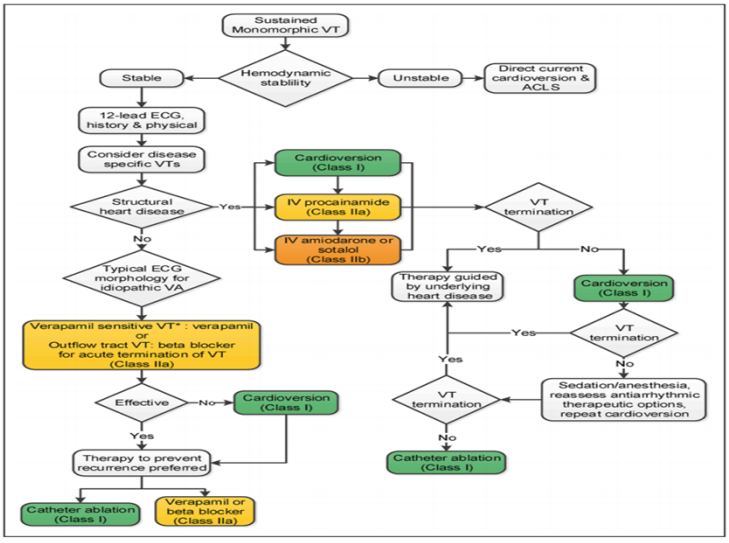
Drug-ICD interactions must be considered.

- Antiarrhythmic drugs with sodium channel blocking properties may increase the defibrillation threshold.
- Pure class III agents are unlikely to do so and may actually decrease defibrillation energy requirements. Pacing thresholds may rarely be affected.
- Antiarrhythmic drugs frequently prolong VT cycle lengths and may require changes in programmed detection zones.
- Antiarrhythmic drugs may result in sinus bradycardia or worsen AV conduction, increasing the need for atrial and/or ventricular pacing

Device Therapy in Heart Failure

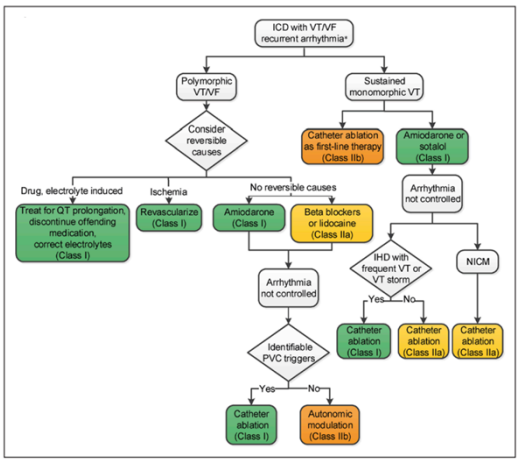
Primary and Secondary ICD Prevention Trials

Trial	Randomization	Year	Patients	Entry Criteria	Mortality Risk Reduction with ICD
Primary Prevention ICD Trials					
MADIT [65]	ICD versus medical therapy	1996	196	NYHA I–II with prior MI and LVEF ≤35% with inducible VT	0.46 (P = .009)
CABG-PATCH [67]	Epicardial ICD versus no ICD	1997	900	LVEF ≤35% with abnormal SAECG and CABG	1.07 (P = .64)
MADIT II [63]	ICD versus no ICD	2002	1232	NYHA class I–III with LVEF ≤30% post MI	0.69 (P = .016)
DINAMIT [69]	ICD or no ICD (<40 days after MI)	2004	674	Up to 40 days post MI with LVEF ≤ 35%	1.08 (P = .78)
DEFINITE [68]	ICD versus no ICD	2004	458	Nonischemic heart failure patients, LVEF <36% with >10 PVCs/hr or NSVT	0.65 (P = .08)
SCD-HeFT [61]	ICD versus amiodarone versus placebo	2005	2521	NYHA II–III and LVEF ≤35%; ischemic or nonischemic	0.77 (P = .007)
IRIS [70]	Randomized to ICD versus no ICD	2009	898	Up to 31 days post MI with LVEF ≤ 40%, NSVT or HR >90	1.04 (P = .78)
Secondary Prevention ICD Trials					
AVID [62]	ICD versus amiodarone	1997	1016	VF arrest or VT and syncope with EF ≤40%	0. 73 (P < .02)
CIDS [63]	Amiodarone versus ICD	2000	696	VF/VT arrest or syncope	0. 70 (P = .142)
CASH [64]	ICD versus amiodarone versus metoprolol	2000	346	VT/VF arrest	0.61 (P = .2)



2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

Catheter Ablation of Ventricular Tachycardia



2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

Catheter Ablation of Ventricular Tachycardia

Recommendations for Treatment of Recurrent VA in Patients With NICM

References that support the recommendations are summarized in Online Data Supplement 29.

COR	LOE	Recommendations
IIa	B-R	1. In patients with NICM and an ICD who experience spontaneous VA or recurrent appropriate shocks despite optimal device programming and treatment with a beta blocker, amiodarone or sotalol can be beneficial.[57.2.3-1]
IIa	B-NR	2. In patients with NICM and recurrent sustained monomorphic VT who fail or are intolerant of antiarrhythmic medications, catheter ablation can be useful for reducing recurrent VT and ICD shocks.[57.2.3-2,57.2.3-3]

Thank you