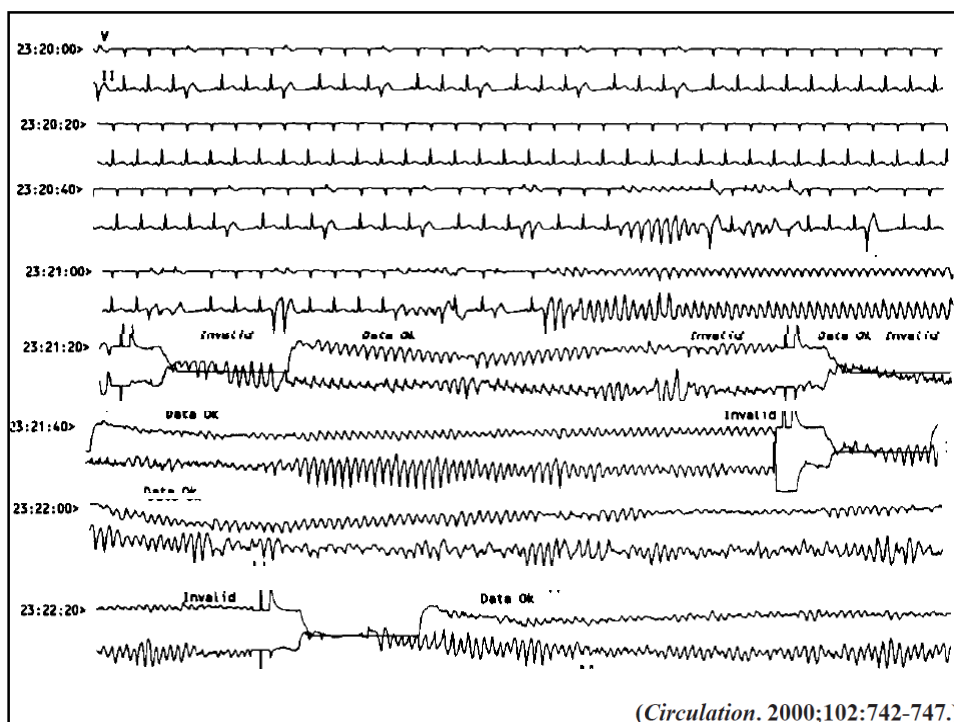


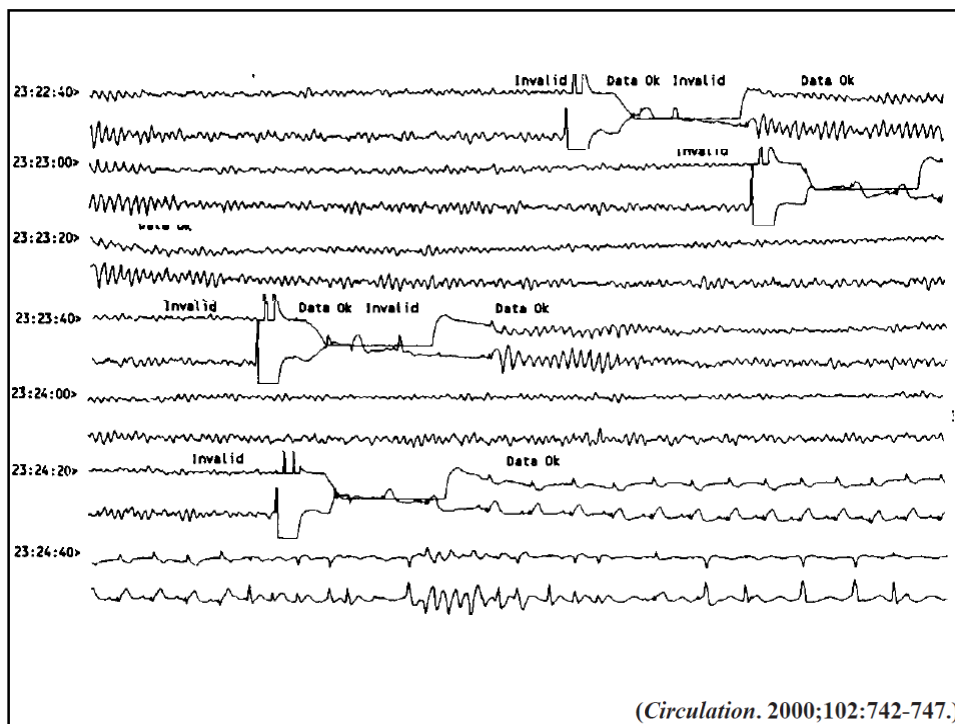
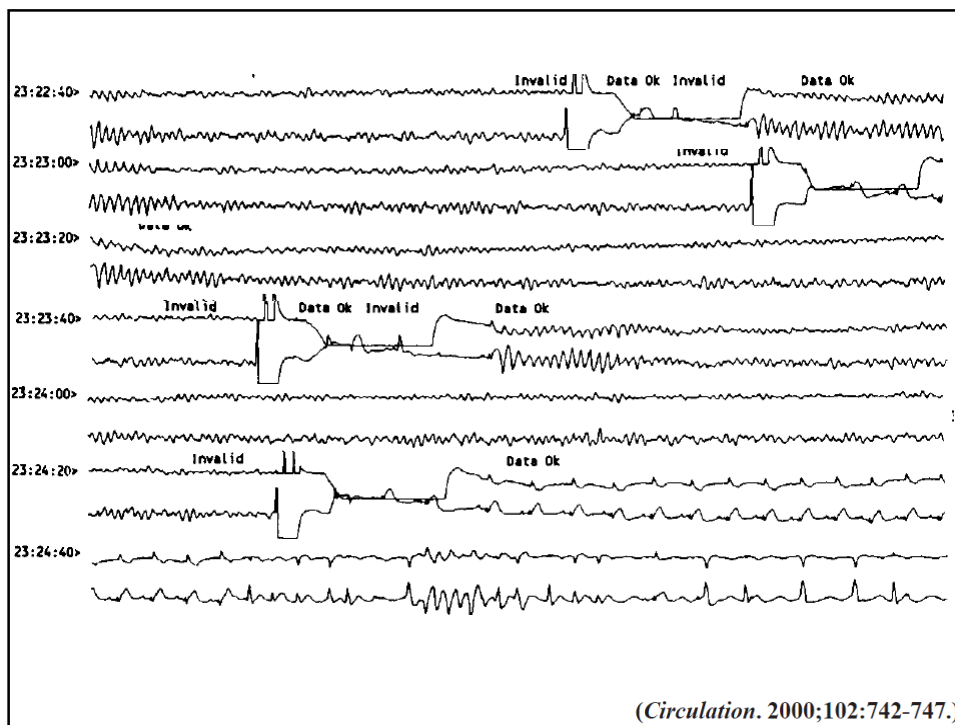


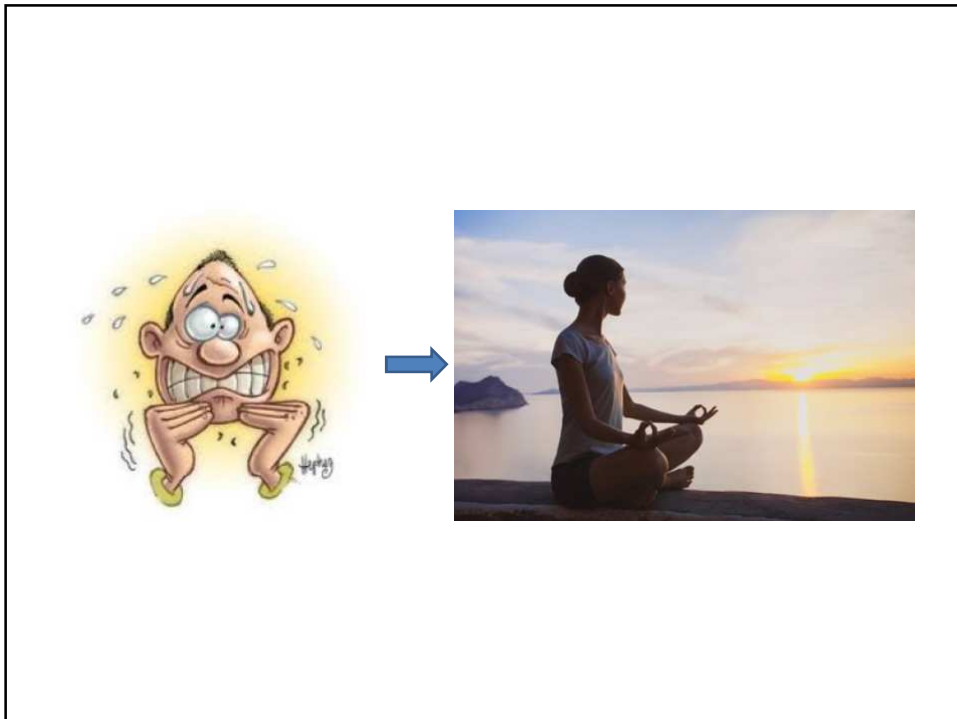
Prise en charge de l'orage rythmique

Journée des filières RESURCOR - RENAIR
30/11/2017

Dr Raoul BACQUELIN





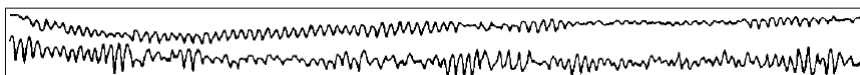




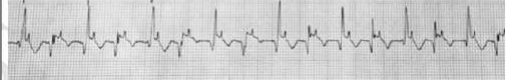
2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

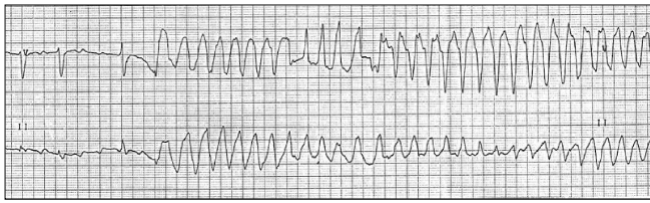
A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society

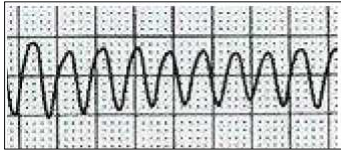
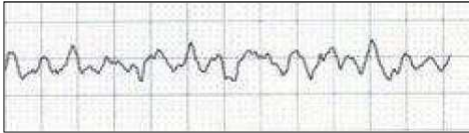
Définitions

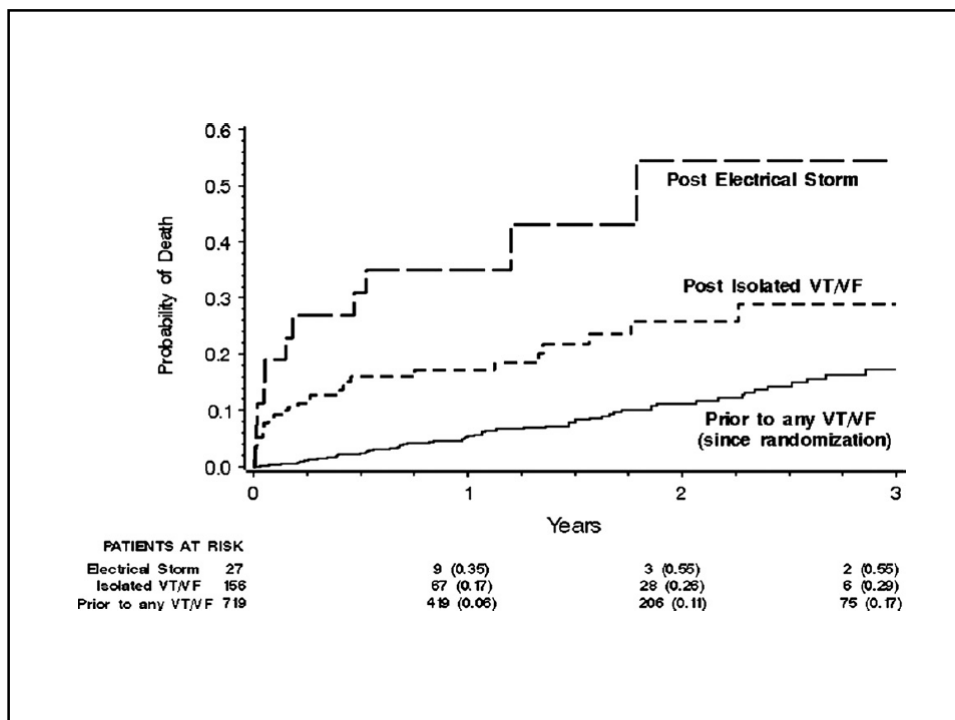
VT/VF storm (3)	VT/VF storm (electrical storm or arrhythmic storm) refers to a state of cardiac electrical instability that is defined by ≥ 3 episodes of sustained VT, VF, or appropriate shocks from an ICD within 24 h.
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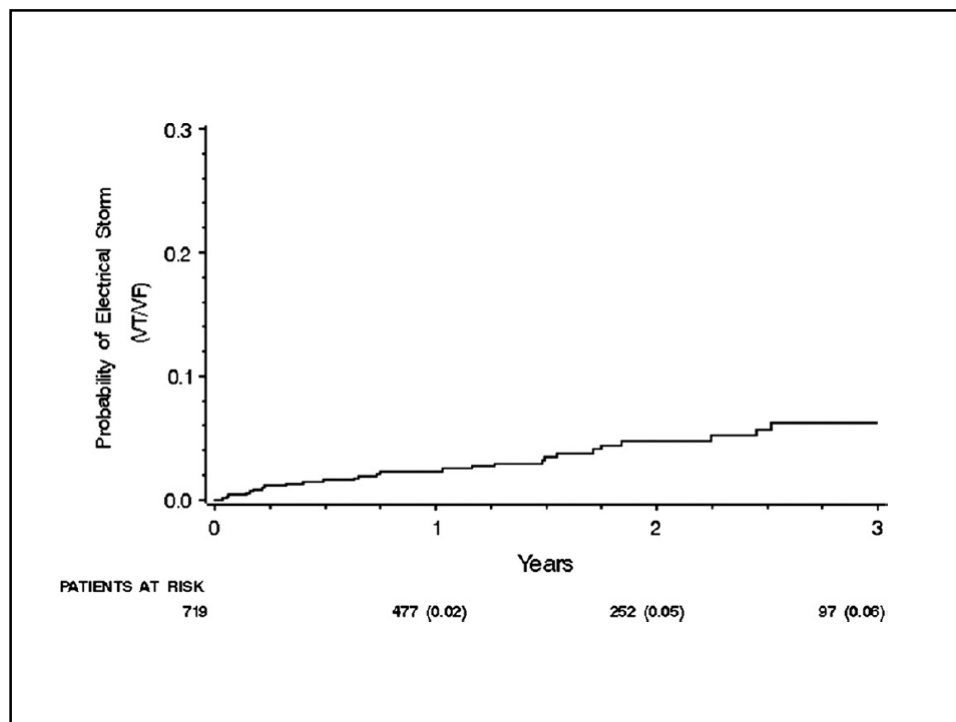


Ventricular tachycardia (2)	<p>Cardiac arrhythmia of ≥ 3 consecutive complexes originating in the ventricles at a rate >100 bpm (cycle length: <600 ms). Types of VT:</p> <ul style="list-style-type: none"> • Sustained: VT >30 s or requiring termination due to hemodynamic compromise in <30 s. • Nonsustained/unsustained: ≥ 3 beats, terminating spontaneously. • Monomorphic: Stable single QRS morphology from beat to beat. • Polymorphic: Changing or multiform QRS morphology from beat to beat. • Bidirectional: VT with a beat-to-beat alternation in the QRS frontal plane axis, often seen in the setting of digitalis toxicity or catecholaminergic polymorphic VT
<div style="text-align: center;"> <p>Monomorphic VT</p>  <p>Polymorphic VT</p>  <p>Bidirectional VT</p>  </div>	

Torsades de pointes (2)	<p>Torsades de pointes is polymorphic VT that occurs in the setting of a long-QT interval and is characterized by a waxing and waning QRS amplitude. It often has a long-short initiating sequence with a long coupling interval to the first VT beat and may present with salvos of NSVT. The twisting of the points, although characteristic, may not always be seen, especially if the episode is nonsustained or if only a limited number of leads are available. Torsades de pointes can result from bradycardia including high-grade AV block that leads to a long-short sequence initiating torsades de pointes.</p>
	

Ventricular flutter (2)	A regular VA ≈ 300 bpm (cycle length: 200 ms) with a sinusoidal, monomorphic appearance; no isoelectric interval between successive QRS complexes.
	
Ventricular fibrillation (2)	Rapid, grossly irregular electrical activity with marked variability in electrocardiographic waveform, ventricular rate usually >300 bpm (cycle length: <200 ms).
	





Epidémiologie

- Cas particulier des DAI: orage rythmique chez:
 - 5 à 20% des patients implantés en prévention primaire
 - 10 à 40% des patients implantés en prévention secondaire
 - 7% des patients implantés pour une resynchronisation

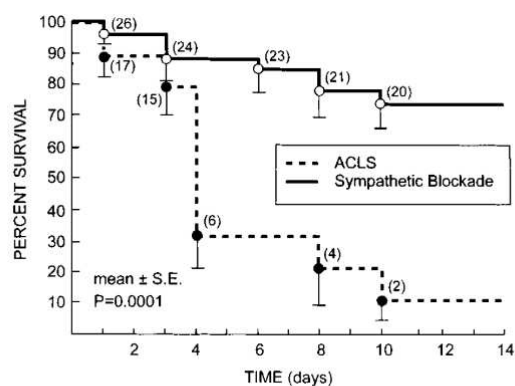


Figure 5. Kaplan-Meier survival curves for group 1 (conventional treatment) and group 2 (sympathetic blockade). Numbers in parentheses are number of patients remaining at risk at each interval.

(*Circulation.* 2000;102:742-747.)

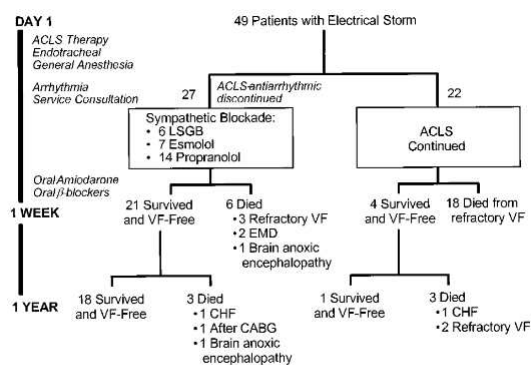
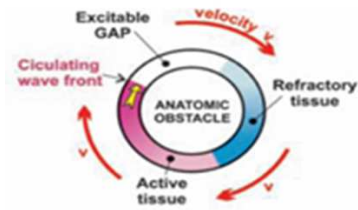


Figure 4. Courses of and outcomes of treatment for patients in group 1 (sympathetic blockade) and group 2 (treatment guided by ACLS recommendations). EMD indicates electromechanical dissociation; CHF, congestive heart failure.

(*Circulation.* 2000;102:742-747.)

Physiopathologie



- TV monomorphes soutenues :
 - Cicatrice d'IdM
 - Zone de fibrose sur cardiopathie à coronaires saines
 - Patch ou incision sur cardiopathie congénitale opérée.
- FV et TV polymorphes : mécanisme moins clair.
 - Tissu de Purkinje
 - « Stretch » (étirement) en cas d'élévation des pressions de remplissage
 - Surcharge calcique et/ou anomalies de l'homeostasie calcique
 - Les TdP sur QT long, la bradycardie, les catécholamines, l'hypokaliémie et l'hypomagnésémie favorisent les post-dépolarisations précoces et majorent l'hétérogénéité des périodes réfractaires.

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

Cas généraux

Cardioversion or defibrillation and acute treatment of sustained ventricular arrhythmias

Recommendations	Class ^a	Level ^b	Ref. ^c
Direct current cardioversion is recommended for patients presenting with sustained VT and haemodynamic instability.	I	C	180

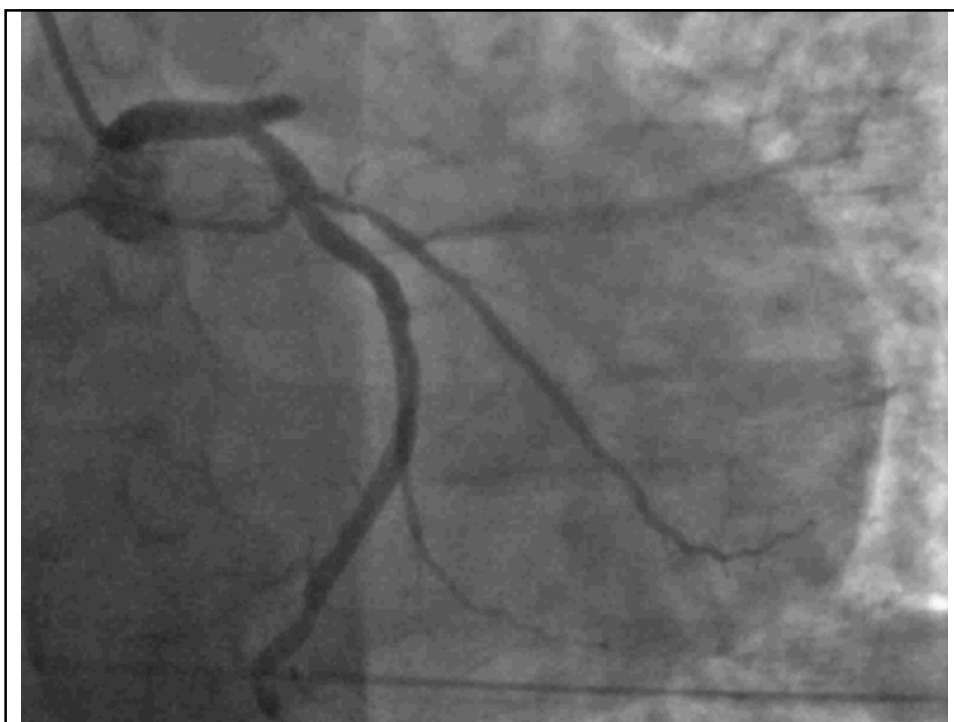
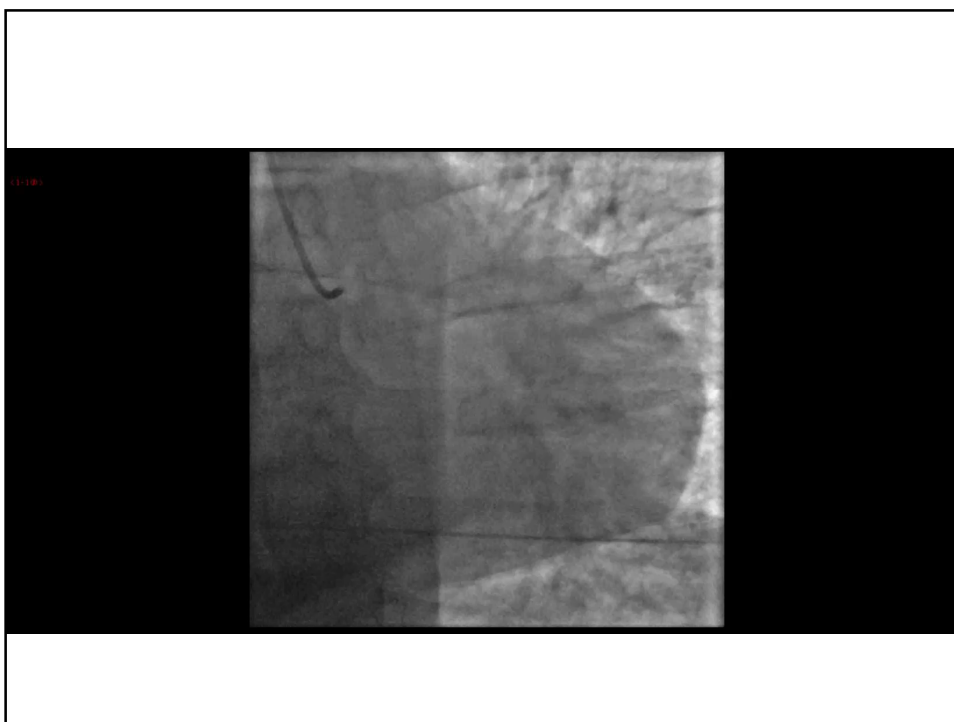
2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

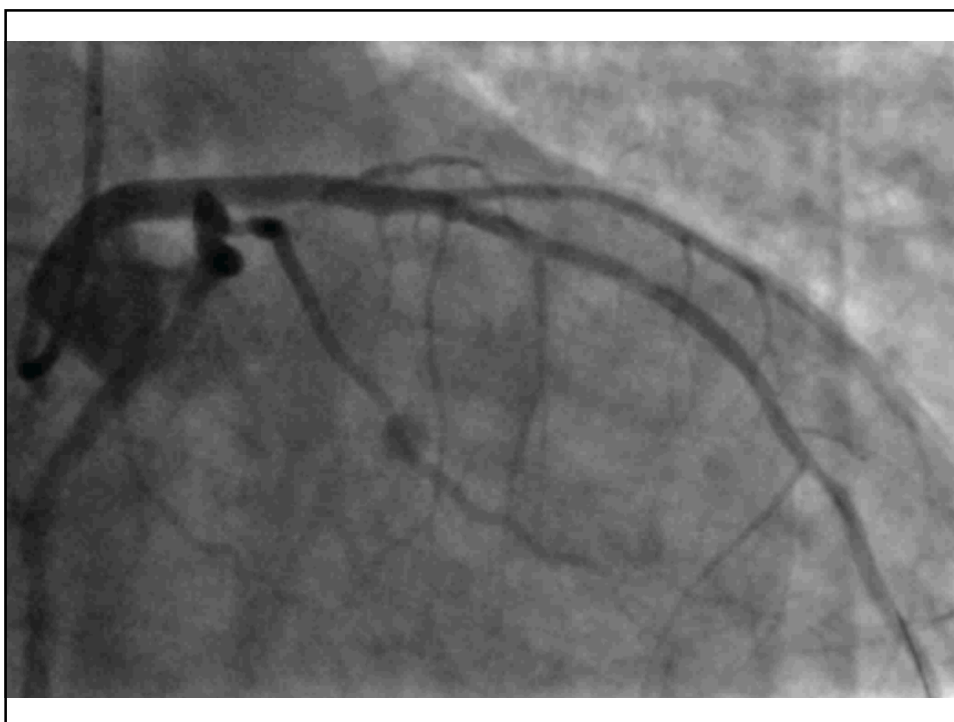
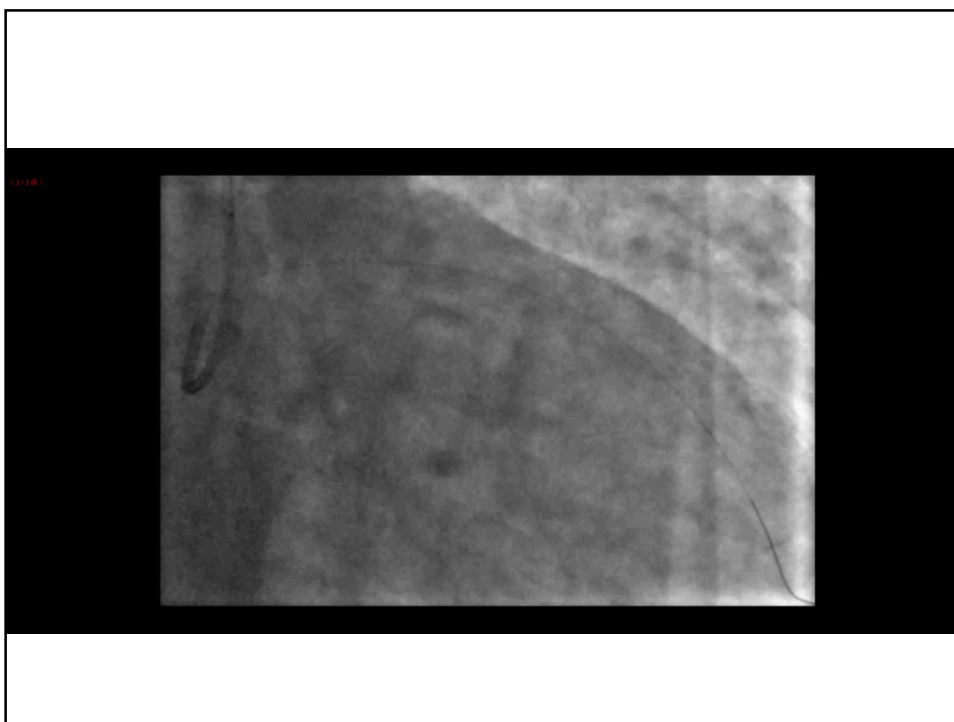
- Cardiopathie ischémique
- Cardiopathie dilatée
- Dysfonction VG systolique
- Syndrome de Brugada
- FV idiopatique
- Torsade de pointes à couplage court

Cardiopathie ischémique

Prevention and management of sudden cardiac death associated with acute coronary syndromes: in-hospital phase. Defibrillation/cardioversion/drugs/catheter ablation

Recommendations	Class ^a	Level ^b	Ref. ^c
<u>Beta-blocker</u> treatment is recommended for recurrent polymorphic VT.	I	B	257
<u>Intravenous amiodarone</u> is recommended for the treatment of polymorphic VT.	I	C	258
Immediate electrical cardioversion or defibrillation is recommended in patients with sustained VT or VF.	I	C	180
<u>Urgent coronary angiography followed, when indicated, by revascularization</u> is recommended in patients with recurrent VT or VF when myocardial ischaemia cannot be excluded.	I	C	251, 252





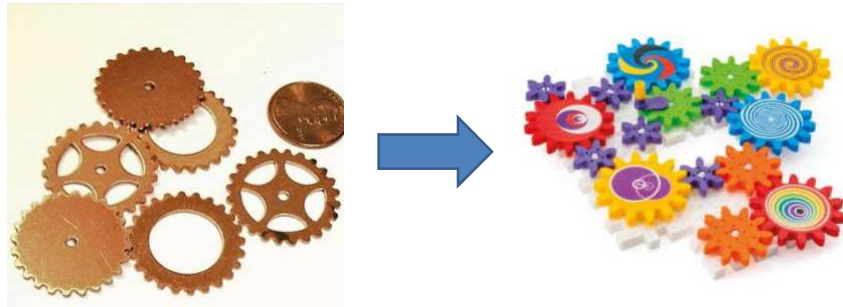
Cardiopathie ischémique	<u>Correction of electrolyte imbalances</u> is recommended in patients with recurrent VT or VF.	I	C	179
	Oral treatment with beta-blockers should be considered during the hospital stay and continued thereafter in all ACS patients without contraindications.	IIa	B	130, 257, 259, 260
	<u>Radiofrequency catheter ablation</u> at a specialized ablation centre followed by the implantation of an ICD should be considered in patients with recurrent VT, VF or <u>electrical storms despite complete revascularization and optimal medical treatment</u> .	IIa	C	261–267
	Transvenous catheter overdrive stimulation should be considered if VT is frequently recurrent despite use of anti-arrhythmic drugs and catheter ablation is not possible.	IIa	C	
	<u>Intravenous lidocaine</u> may be considered for the treatment of recurrent sustained VT or VF not responding to <u>beta-blockers or amiodarone</u> or in the presence of contraindications to amiodarone.	IIb	C	268

Cardiopathie ischémique

5.1.3.5 Sustained VT and VF

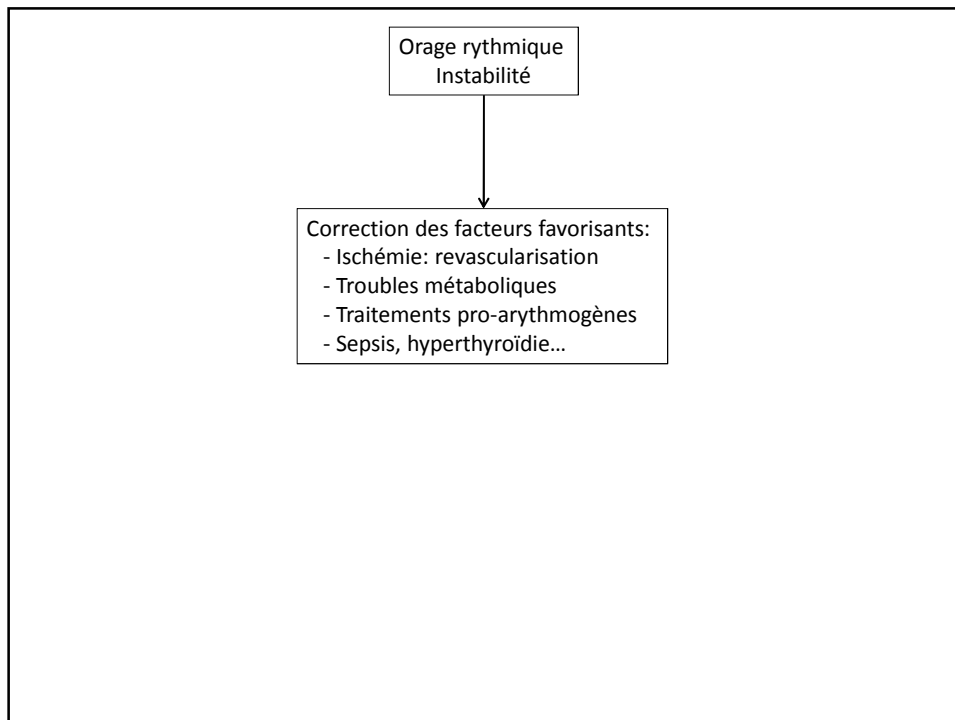
Recurrent sustained VT, especially when polymorphic, or recurrent VF may be an indicator of incomplete reperfusion or recurrence of acute ischaemia. Immediate coronary angiography should therefore be considered.^{250,271} Recurrent polymorphic VT degenerating into VF may respond to beta-blockers. In addition, deep sedation may be helpful to reduce episodes of VT or VF. Amiodarone (150–300 mg i.v. bolus) should be considered to acutely suppress recurrent haemodynamically relevant VAs. The use of other anti-arrhythmic drugs in ACS (e.g. procainamide, propafenone, ajmaline, flecainide) is not recommended.^{1,269,271}

En pratique



En pratique

- Corriger un facteur favorisant / une cause aiguë réversible
- Traitement médicamenteux
- Thérapeutique:
 - Sédation profonde
 - Assistance circulatoire
 - Ablation

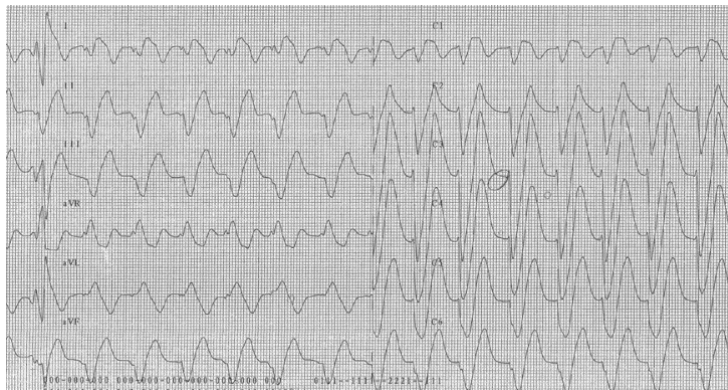


En pratique

- Corriger un facteur favorisant:
 - Ischémie myocardique : revascularisation

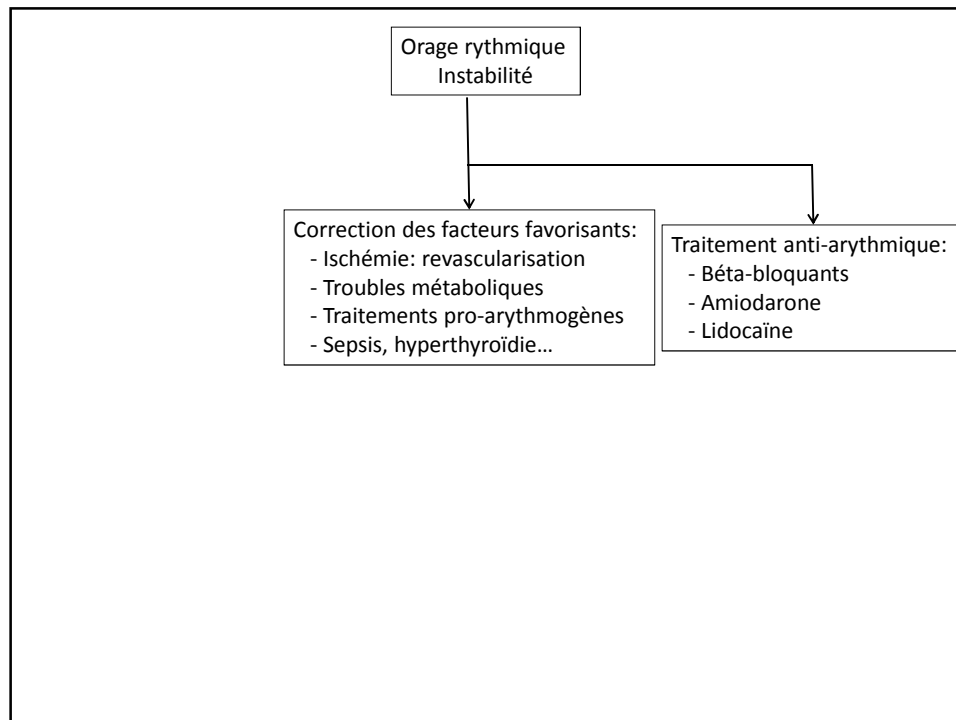
En pratique

- Corriger un facteur favorisant:
 - Ischémie myocardique : revascularisation
 - Troubles métaboliques



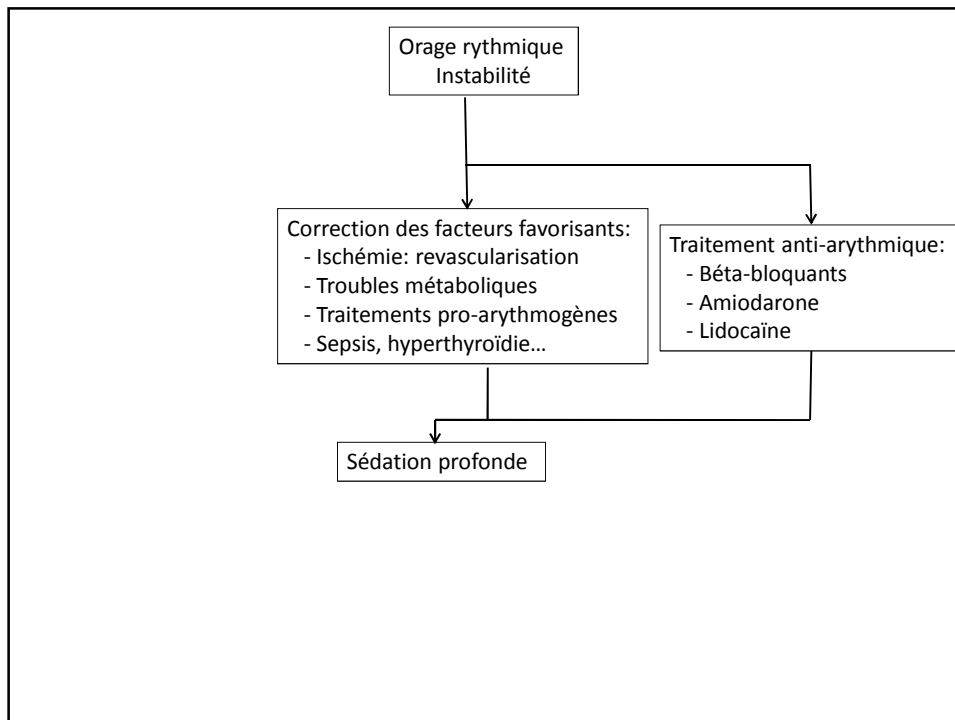
En pratique

- Corriger un facteur favorisant:
 - Ischémie myocardique : revascularisation
 - Troubles métaboliques
 - Médicaments : médicaments pro-arythmogènes, interactions médicamenteuses
 - Elévation des pressions de remplissage
 - Sepsis, hyperthyroïdie...
- Bilan biologique systématique:
 - Ionogramme sanguin: K, Ca, Mg
 - Troponine
 - TSH



En pratique

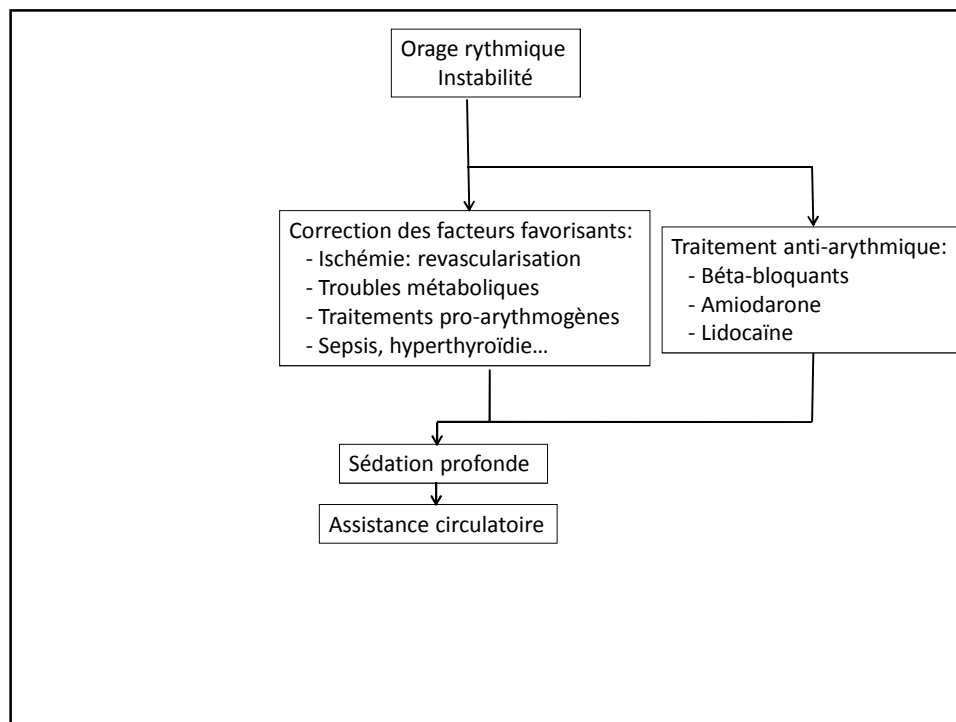
- Traitement médicamenteux
 - Béta-bloquants:
 - Par exemple Aténolol 5 mg IV sur 5 min.
 - Amiodarone (Cordarone®):
 - 5 mg/kg IVL sur 20-30 minutes
 - Pas de bolus +++
 - Puis: 10-20 mg/kg/24 h IVSE (600 – 1200 mg/24h).
 - VVC
 - Lidocaïne (Xylocard®):
 - Surtout phase aiguë infarctus du myocarde
 - 1 mg/kg IVD (bolus) (solution 20 mg/ml)
 - 1,5 -> 4 mg/min IVSE (solution 50 mg/ml)
 - Contre-indiqué si trouble de conduction AV sous-jacent sans sonde d'entraînement électro-systolique.



En pratique

- Sédation profonde: diminution de la stimulation adrénergique

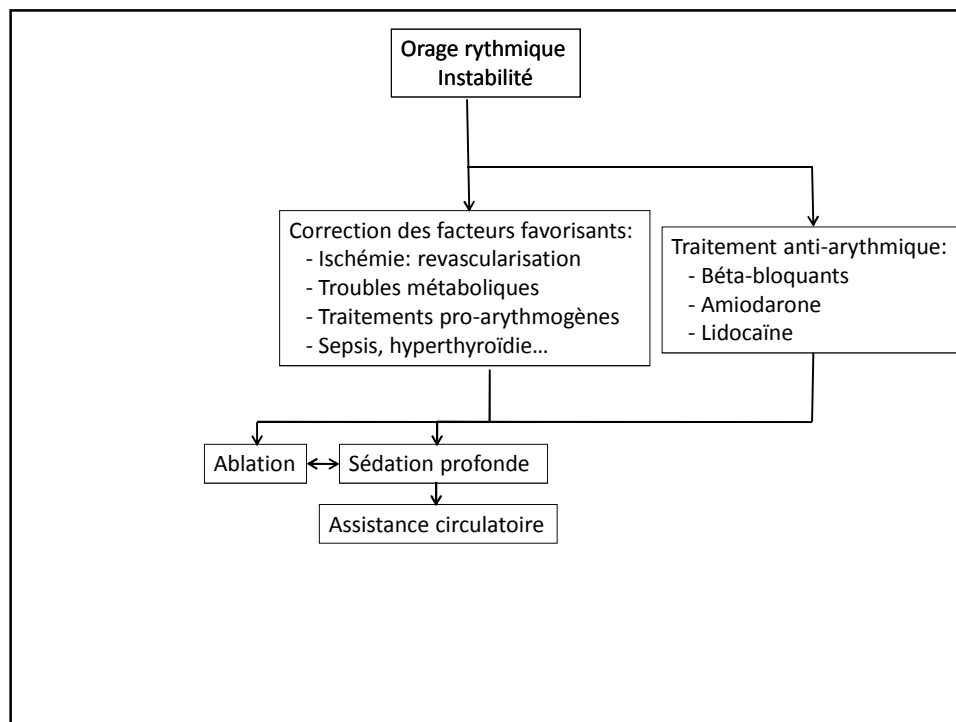




En pratique

- Sédation profonde: diminution de la stimulation adrénergique
- Assistance circulatoire: ECMO

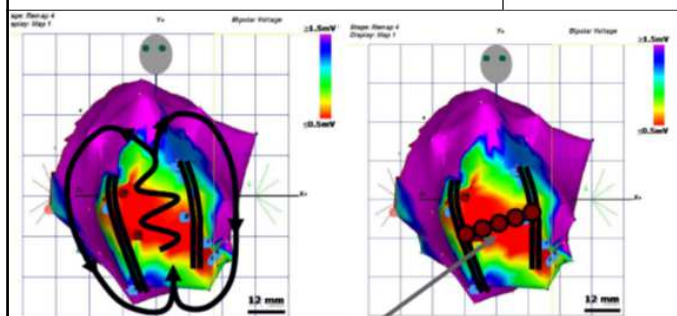
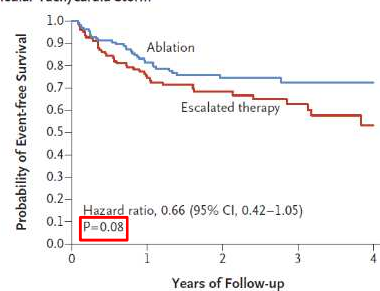




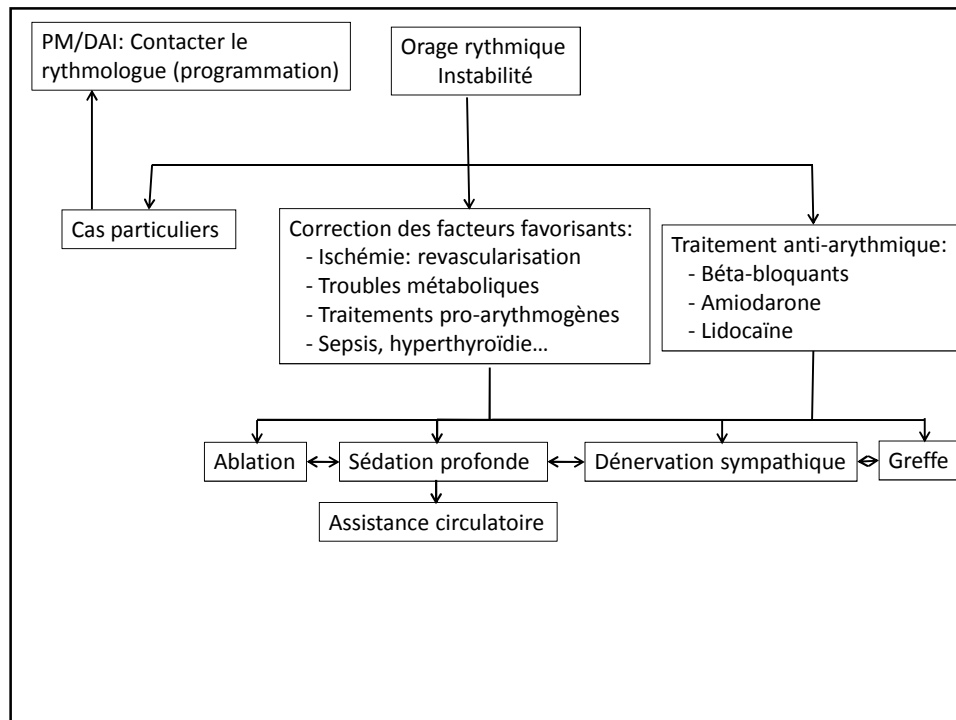
En pratique

- Discuter une ablation en urgence

C Ventricular Tachycardia Storm

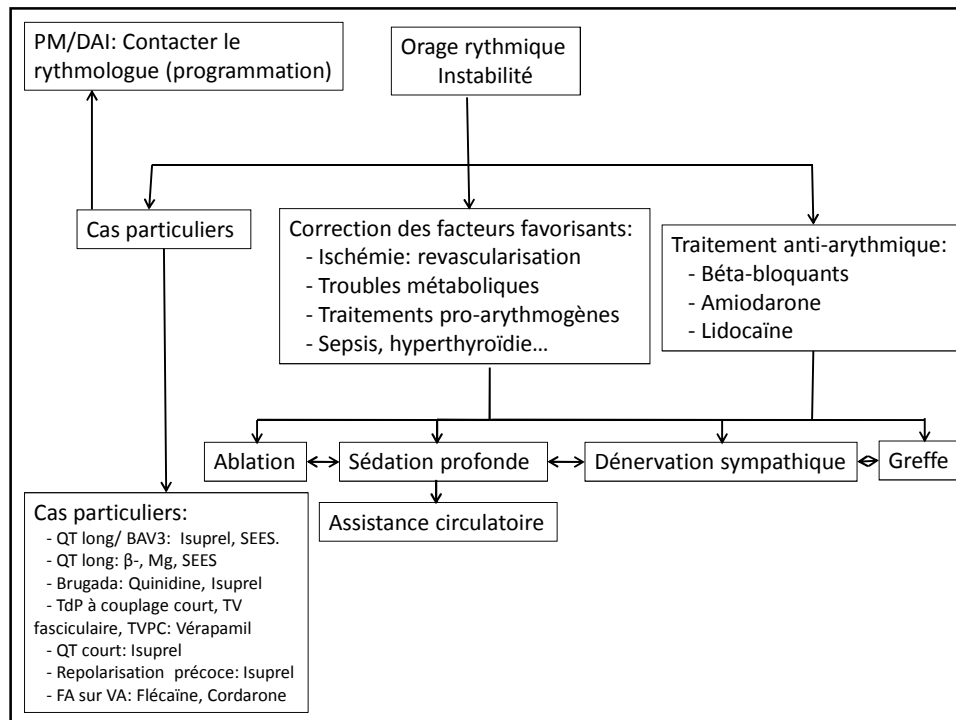


N Engl J Med 2016;375:111-21.



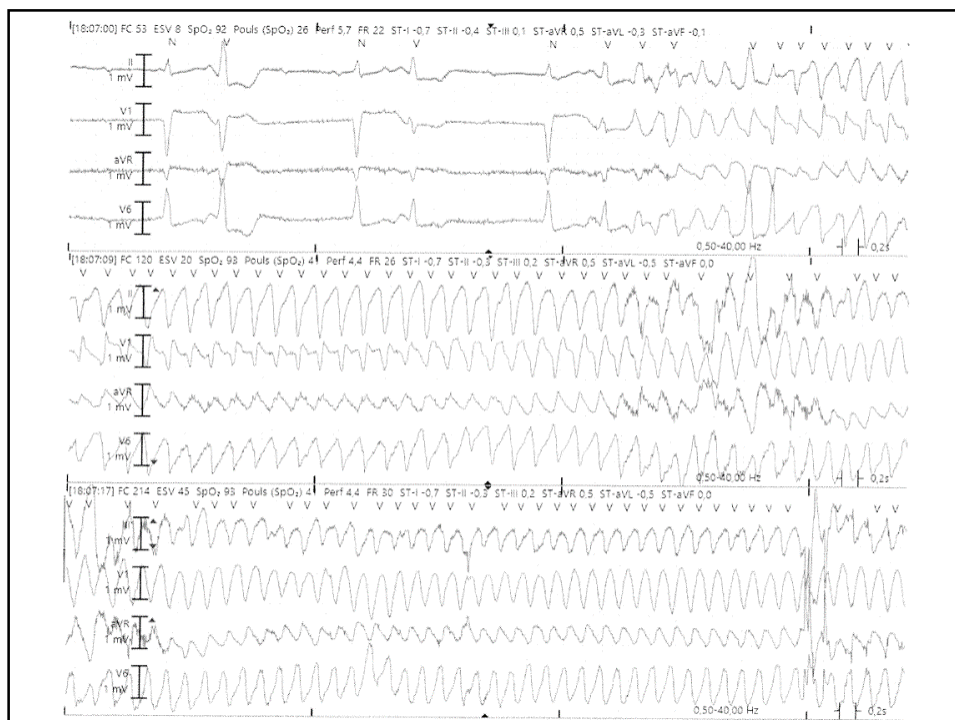
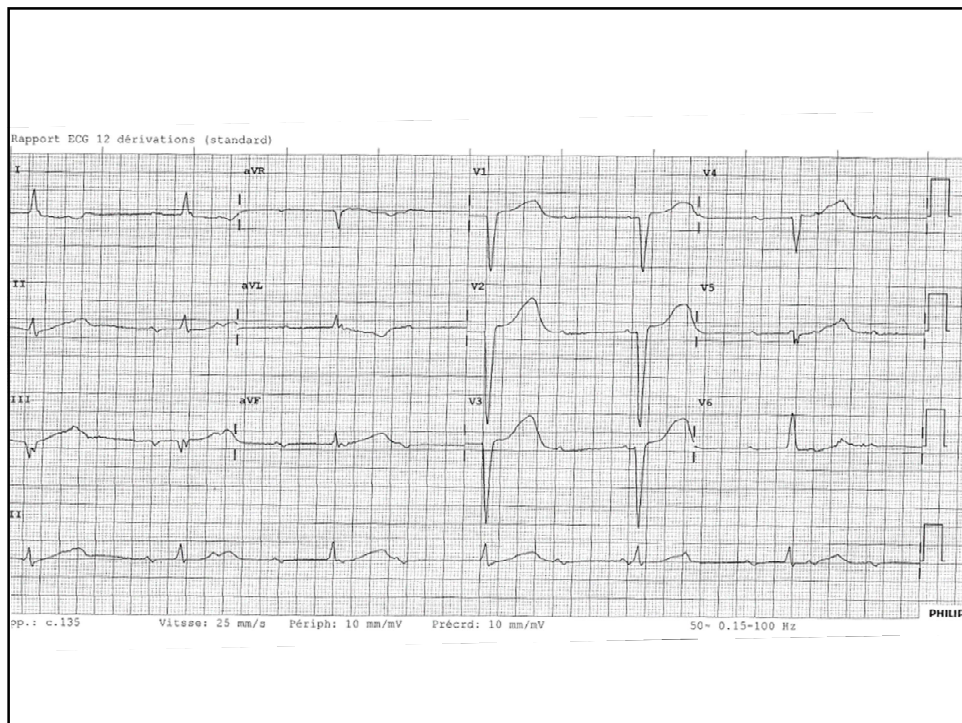
En pratique

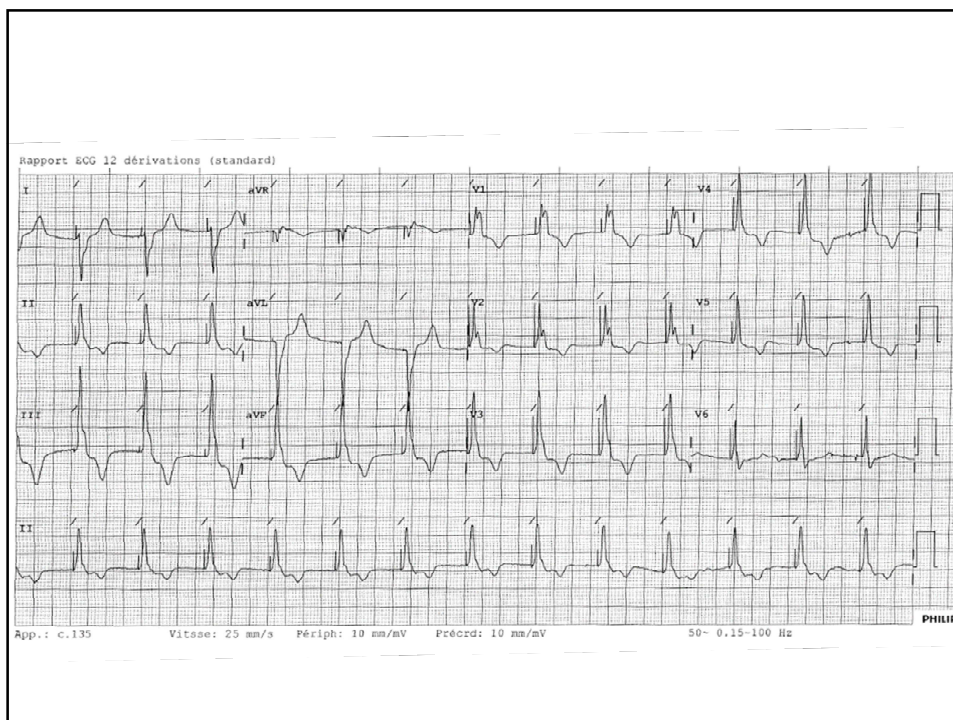
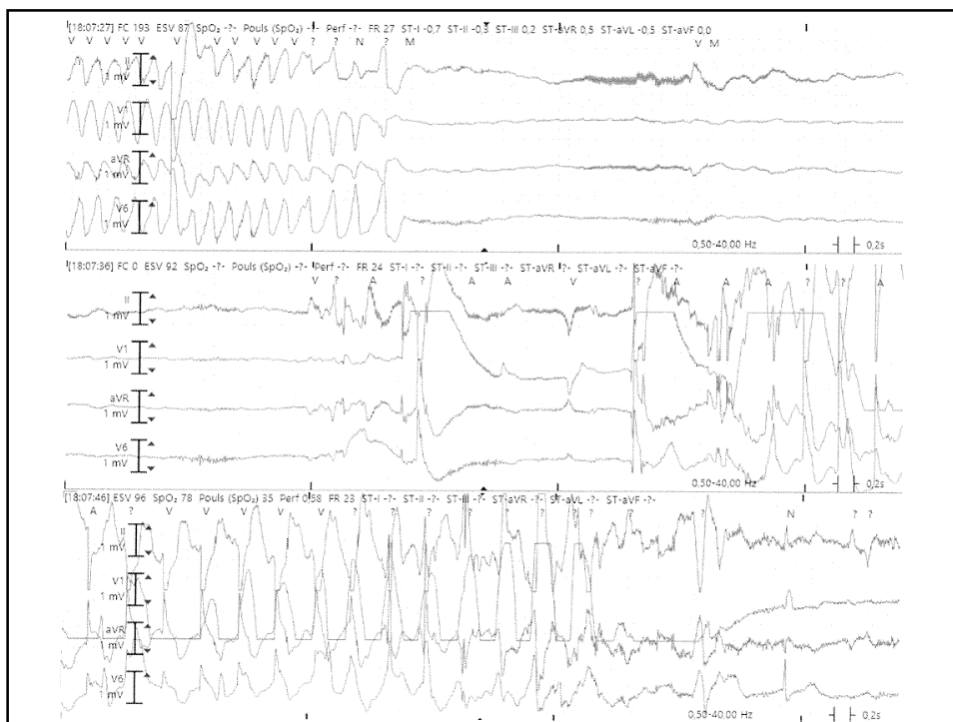
- Mesures spécifiques liées aux porteurs de stimulateur cardiaque ou de DAI:
 - Contacter le rythmologue
 - Contrôle prothèse pour rechercher un effet pro-arythmique et/ou défaut de fonctionnement.
 - Si DAI: réglage des thérapies

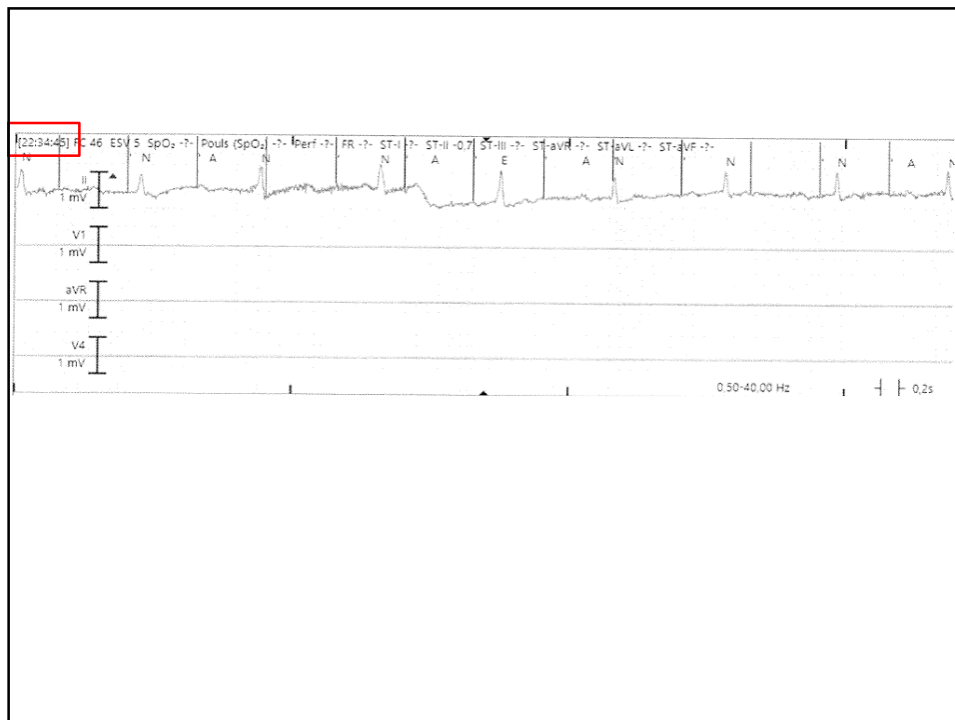


Cas particuliers

- **Cas particuliers: torsade de pointes sur QT long:**
 - Si QT long congénital: β^- + sulfate de Mg (3g IVD puis 6g/24h) + potassium voire SEES. Contre-indication Isoprotérénol
 - Si QT long acquis: sulfate de Mg (3g IVD puis 6g/24h) voire SEES. Arrêt des médicaments allongeant le QT.
 - Si QT long sur bradycardie: Isoprotérénol ou SEES





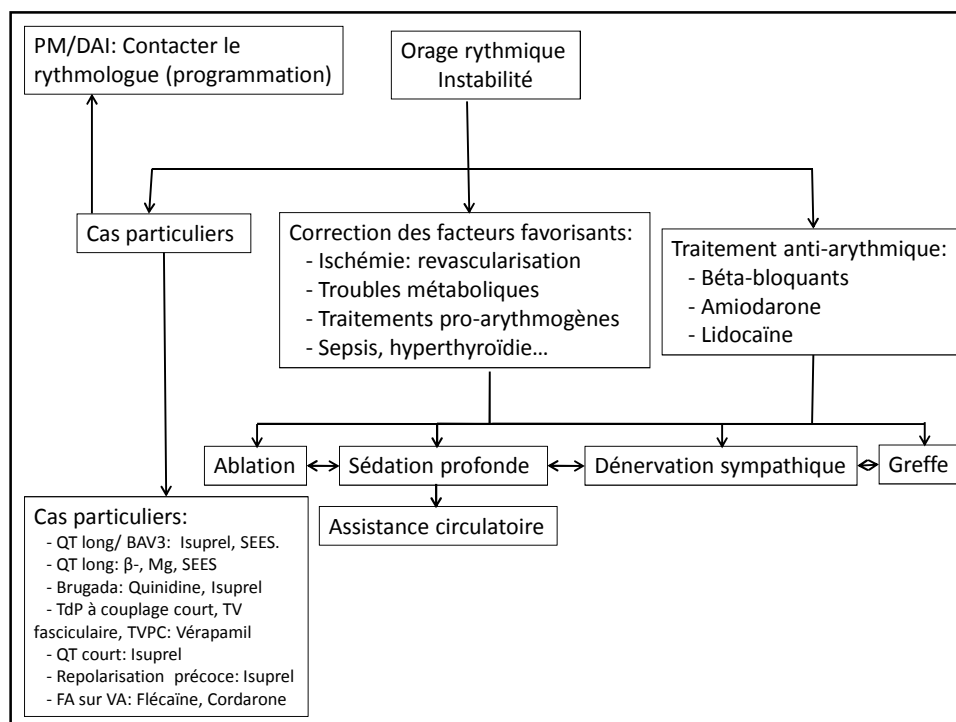
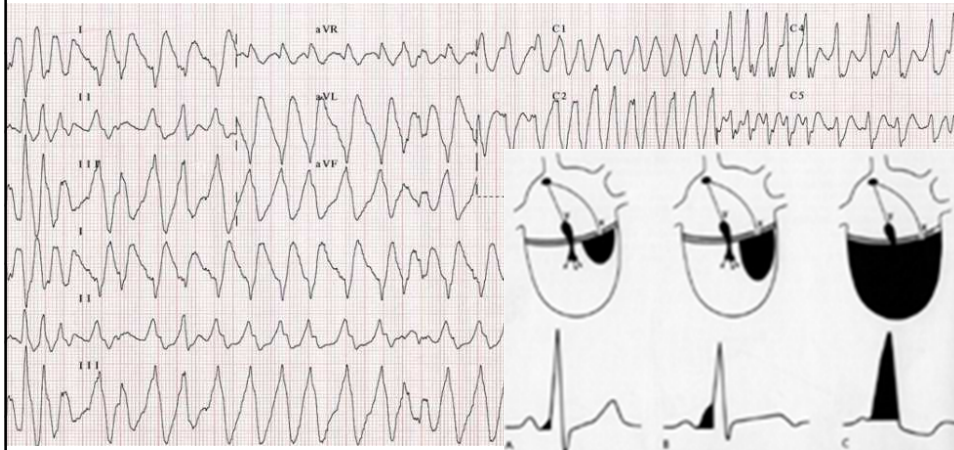


Cas particuliers

- Cas particuliers: autres:
 - TV polymorphe catécholergique
 - TV fasciculaire
 - TdP couplage court
 - Brugada: Quinidine ou Isoprotérénol.
 - Repolarisation précoce
 - QT court
- } Vérapamil IV 5 mg sur 5 min
 Tildiem IV 0,25mg/kg sur 2 min.
- } Isoprotérénol

Cas particuliers

- FA avec préexcitation ventriculaire:
 - AAR classe Ic ou Amiodarone.
 - CI β -, Inhibiteurs calciques bradycardisants, digoxine, ATP (Striadyne, Krenosin).





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

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**A Report of the American College of Cardiology/American Heart Association Task Force on
Clinical Practice Guidelines and the Heart Rhythm Society**

Merci

Dysfonction VG systolique

6.3 Sustained ventricular tachycardia

6.3.1 Drug therapy

Treatment of patients with left ventricular dysfunction and sustained recurrent monomorphic ventricular tachycardia

Recommendations	Class ^a	Level ^b	Ref. ^c
Optimization of HF medication according to current HF guidelines is recommended in patients with LV dysfunction and sustained VT.	I	C	8
<u>Amiodarone</u> treatment should be considered to prevent VT in patients with or without an ICD.	IIa	C	64

Dysfonction VG systolique

Prevention of ventricular tachycardia recurrences in patients with left ventricular dysfunction and sustained ventricular tachycardia

Recommendations	Class ^a	Level ^b	Ref. ^c
<u>Urgent catheter ablation</u> in specialized or experienced centres is recommended in patients presenting with incessant VT or electrical storm resulting in ICD shocks.	I	B	183
Amiodarone or catheter ablation is recommended in patients with recurrent ICD shocks due to sustained VT.	I	B	64,156, 184–186

Syndrome de Brugada

Risk stratification and management in Brugada Syndrome

Quinidine or isoproterenol should be considered in patients with Brugada syndrome to treat electrical storms.	IIa	C	453
Quinidine should be considered in patients who qualify for an ICD but present a contraindication or refuse it and in patients who require treatment for supraventricular arrhythmias.	IIa	C	454
ICD implantation may be considered in patients with a diagnosis of Brugada syndrome who develop VF during PVS with two or three extrastimuli at two sites.	IIb	C	120
Catheter ablation may be considered in patients with a history of electrical storms or repeated appropriate ICD shocks.	IIb	C	201, 455

Cardiopathie dilatée

Risk stratification and management of patients with dilated cardiomyopathy

Catheter ablation is recommended in patients with DCM and bundle branch re-entry ventricular tachycardia refractory to medical therapy.	I	B	8,208, 345, 346
Catheter ablation may be considered in patients with DCM and VA not caused by bundle branch re-entry refractory to medical therapy.	IIb	C	355

FV idiopathique

Treatment of idiopathic ventricular fibrillation

Recommendations	Class ^a	Level ^b	Ref. ^c
ICD implantation is recommended in survivors of idiopathic VF.	I	B	154, 583
Catheter ablation of PVCs triggering recurrent VF leading to ICD interventions is recommended when performed by experienced operators.	I	B	467, 584–587
<u>Catheter ablation of PVCs</u> leading to electrical storm is recommended when performed by experienced operators.	I	B	467, 584–587

Torsade de pointes à couplage court

Treatment of short-coupled torsade de pointes

Recommendations	Class ^a	Level ^b	Ref. ^c
ICD is recommended in patients with conclusive diagnosis of short-coupled TdP.	I	B	589
<u>Intravenous verapamil</u> to acutely suppress/prevent an electrical storm or recurrent ICD discharges should be considered.	IIa	B	590, 591
<u>Catheter ablation</u> for long-term suppression/prevention of an electrical storm or recurrent ICD discharges should be considered.	IIa	B	586

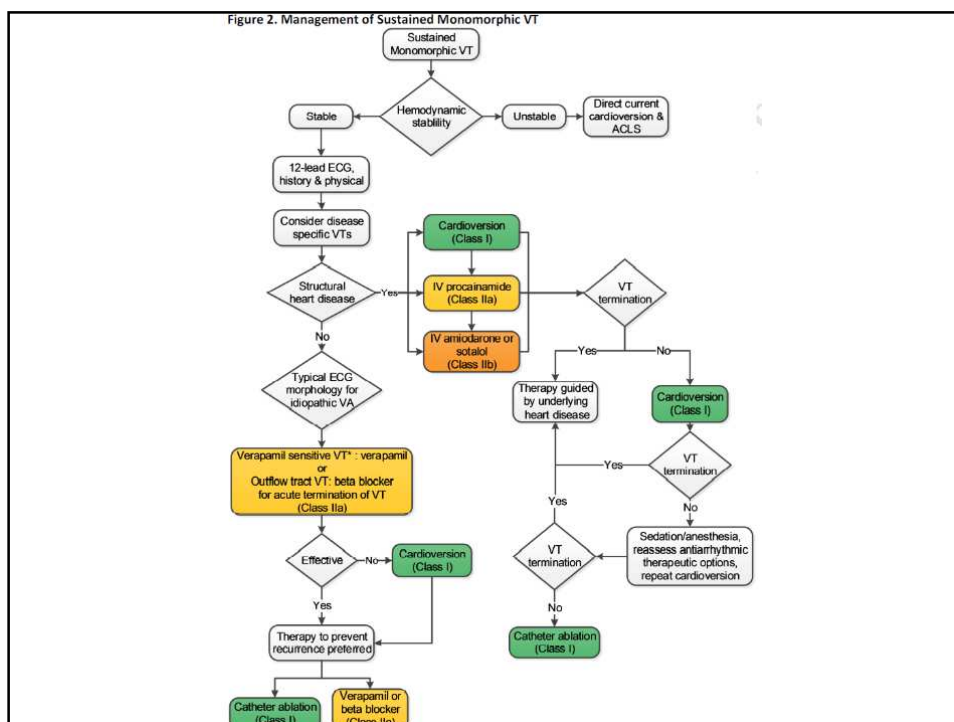
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A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society

Developed in Collaboration With the Heart Failure Society of America

CLASS (STRENGTH) OF RECOMMENDATION	
CLASS I (STRONG) Benefit >>> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> Is recommended Is indicated/useful/effective/beneficial Should be performed/administered/other Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> Treatment/strategy A is recommended/indicated in preference to treatment B Treatment A should be chosen over treatment B 	
CLASS IIa (MODERATE) Benefit >> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> Is reasonable Can be useful/effective/beneficial Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> Treatment/strategy A is probably recommended/indicated in preference to treatment B It is reasonable to choose treatment A over treatment B 	CLASS IIb (WEAK) Benefit ≥ Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> May/might be reasonable May/might be considered Usefulness/effectiveness is unknown/unclear/uncertain or not well established
	CLASS III: No Benefit (MODERATE) Benefit = Risk <i>(Generally, LOE A or B use only)</i> Suggested phrases for writing recommendations: <ul style="list-style-type: none"> Is not recommended Is not indicated/useful/effective/beneficial Should not be performed/administered/other
	CLASS III: Harm (STRONG) Risk > Benefit Suggested phrases for writing recommendations: <ul style="list-style-type: none"> Potentially harmful Causes harm Associated with excess morbidity/mortality Should not be performed/administered/other

LEVEL (QUALITY) OF EVIDENCE‡	
LEVEL A	
<ul style="list-style-type: none"> High-quality evidence‡ from more than 1 RCT Meta-analyses of high-quality RCTs One or more RCTs corroborated by high-quality registry studies 	
LEVEL B-R	(Randomized)
<ul style="list-style-type: none"> Moderate-quality evidence‡ from 1 or more RCTs Meta-analyses of moderate-quality RCTs 	
LEVEL B-NR	(Nonrandomized)
<ul style="list-style-type: none"> Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies Meta-analyses of such studies 	
LEVEL C-LD	
(Limited Data)	
<ul style="list-style-type: none"> Randomized or nonrandomized observational or registry studies with limitations of design or execution Meta-analyses of such studies Physiological or mechanistic studies in human subjects 	
LEVEL C-EO	
(Expert Opinion)	
Consensus of expert opinion based on clinical experience	



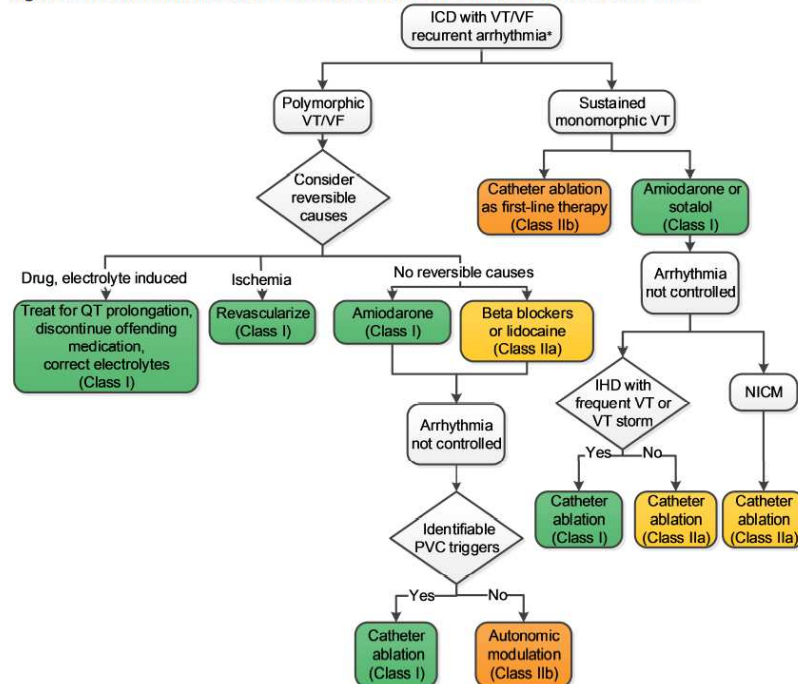
6. Acute Management of Specific VA

I	A	2. In patients with <u>hemodynamically unstable VA that persist or recur after a maximal energy shock, intravenous amiodarone should be administered to attempt to achieve a stable rhythm after further defibrillation (1, 4-6).</u>
I	A	3. Patients presenting with VA with hemodynamic instability should undergo direct current cardioversion (1-3).
I	B-NR	4. In patients with <u>polymorphic VT or VF with ST-elevation MI, angiography with emergency revascularization is recommended (7-10).</u>
I	C-EO	5. Patients with a wide-QRS tachycardia should be presumed to have VT if the diagnosis is unclear.
Ila	B-NR	9. In patients with a recent MI who have <u>VT/VF that repeatedly recurs despite direct current cardioversion and antiarrhythmic medications (VT/VF storm), an intravenous beta blocker can be useful (17, 18).</u>
III: No Benefit	A	12. In patients with cardiac arrest, administration of high-dose epinephrine (>1 mg boluses) compared with standard doses is not beneficial (19, 21).
III: No Benefit	A	13. In patients with <u>refractory VF not related to torsades de pointes, administration of intravenous magnesium is not beneficial (27, 28).</u>

7.1.3. Treatment and Prevention of Recurrent VA in Patients With Ischemic Heart Disease

Recommendations for Treatment of Recurrent VA in Patients With Ischemic Heart Disease		
References that support the recommendations are summarized in Online Data Supplement 22 and 23.		
COR	LOE	Recommendations
I	B-R	1. In patients with <u>ischemic heart disease and recurrent VA</u> , with significant symptoms or ICD shocks despite optimal device programming and ongoing treatment with a beta blocker, amiodarone or sotalol is useful to suppress recurrent VA (1-3).
I	B-R	2. In patients with prior MI and recurrent episodes of symptomatic sustained VT, or who present with <u>VT or VF storm and have failed or are intolerant of amiodarone (LOE: B-R) (4) or other antiarrhythmic medications (LOE: B-NR) (5-9), catheter ablation is recommended (10-12).</u>
	B-NR	
III: Harm	B-R	4. In patients with prior MI, class IC antiarrhythmic medications (e.g., flecainide and propafenone) should not be used (13).
III: Harm	C-LD	5. In patients with incessant VT or VF, an ICD should not be implanted until sufficient control of the VA is achieved to prevent repeated ICD shocks (14).
III: No Benefit	C-LD	6. In patients with <u>ischemic heart disease and sustained monomorphic VT, coronary revascularization alone is an ineffective therapy to prevent recurrent VT (15, 16).</u>

Figure 5. Treatment of Recurrent VA in Patients With Ischemic Heart Disease or NICM



7.5. Myocarditis

Recommendations for Myocarditis

References that support the recommendations are summarized in Online Data Supplement 32.

COR	LOE	Recommendations
I	C-LD	1. In patients with life-threatening VT or VF associated with confirmed or clinically suspected myocarditis, referral to centers with mechanical hemodynamic support and advanced arrhythmia management is recommended (1).

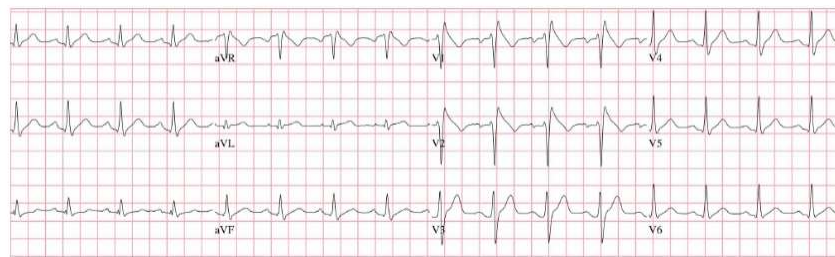
7.9.1.3. Brugada Syndrome

Recommendations for Brugada Syndrome

References that support the recommendations are summarized in Online Data Supplement 42 and Systematic Review Report.

I	B-NR	3. In patients with Brugada syndrome experiencing recurrent ICD shocks for polymorphic VT, <u>intensification of therapy with quinidine or catheter ablation is recommended (7-11).</u>
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Figure 15. Brugada Syndrome



7.9.1.5. Short QT Syndrome

Recommendations for Short QT Syndrome

References that support the recommendations are summarized in Online Data Supplement 44.

IIa	C-LD	4. In patients with short QT syndrome and VT/VF storm, <u>isoproterenol infusion can be effective (7).</u>
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10.2. Pregnancy

Recommendations for Pregnancy

References that support the recommendations are summarized in Online Data Supplement 51.

I	C-EO	2. In the pregnant patient with sustained VA, <u>electrical cardioversion is safe and effective and should be used with standard electrode configuration (2, 3).</u>
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10.7. Medication-Induced Arrhythmias

Recommendations for Medication-Induced Arrhythmias

References that support the recommendations are summarized in Online Data Supplement 52 and 53.

Digoxin		
COR	LOE	Recommendation
I	B-NR	1. Administration of digoxin antibodies is recommended for patients who present with sustained VA potentially due to digoxin toxicity (1, 2).
Medication-Induced QT Prolongation and Torsades de Pointes		
COR	LOE	Recommendations
I	B-NR	2. In patients with recurrent torsades de pointes associated with <u>acquired QT prolongation and bradycardia that cannot be suppressed with intravenous magnesium administration, increasing the heart rate with atrial or ventricular pacing or isoproterenol are recommended to suppress the arrhythmia (3).</u>
I	C-LD	3. For patients with <u>QT prolongation due to a medication, hypokalemia, hypomagnesemia, or other acquired factor and recurrent torsades de pointes, administration of intravenous magnesium sulfate is recommended to suppress the arrhythmia (4, 5).</u>
I	C-LD	4. For patients with torsades de pointes associated with <u>acquired QT prolongation, potassium repletion to 4.0 mmol per L or more and magnesium repletion to normal values (e.g., ≥ 2.0 mmol/L) are beneficial (6, 7).</u>

5.6. Autonomic Modulation

Recommendations for Autonomic Modulation

References that support the recommendations are summarized in Online Data Supplement 13 and 14.

COR	LOE	Recommendations
Ila	C-LD	1. In patients with symptomatic, non-life-threatening VA, treatment with a beta blocker is reasonable (1).
Iib	C-LD	2. In patients with <u>VT/VF storm in whom a beta blocker, other antiarrhythmic medications, and catheter ablation are ineffective, not tolerated, or not possible, cardiac sympathetic denervation may be reasonable (2-4).</u>

EHRA/HRS/APHRS Expert Consensus on Ventricular Arrhythmias

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Sustained polymorphic ventricular tachycardia/ ventricular fibrillation

Expert consensus recommendations on sustained polymorphic VT/VF

1. Patients with polymorphic VT or VF should be thoroughly evaluated for the presence of SHD, inherited arrhythmia syndromes, early repolarization, coronary artery spasm, and pro-arrhythmic effects of medications using:
 - a. Twelve-lead ECG during the arrhythmia (when feasible) and during normal rhythm. I LOE C
 - b. Echocardiography. I LOE B
 - c. Coronary arteriography. I LOE B
2. Specific antiarrhythmic therapies, e.g. quinidine in patients with idiopathic VF, sodium channel blocker therapy in patients with long QT syndrome (LQTS) III, intensive autonomic inhibition in patients with catecholaminergic VTs, or quinidine in BrS, should be considered in close cooperation with a specialist in these diseases to reduce the risk of recurrence as an adjunct to—and rarely as an alternative to—defibrillator therapy in survivors of polymorphic VAs. Detailed guidance can be found in the APHRS/EHRA/HRS document on inherited arrhythmia syndromes. IIa LOE B
3. For patients with VT/VF storm, reversible factors such as electrolyte abnormalities, pro-arrhythmic drugs, ischaemia, and decompensated chronic heart failure should be corrected. I LOE C
4. Pharmacological suppression of VT/VF storm with beta-adrenergic blockers, amiodarone, and/or lidocaine should be considered in all patients. IIa LOE C
5. For patients with VT/VF storm in whom pharmacological suppression has not been effective and who are unstable, neuraxial modulation, mechanical ventilation, catheter ablation, and/or anaesthesia may be considered. IIb LOE C
6. Catheter ablation of VTs or a triggering focus of VF should be considered in patients with VT/VF storm when adequate experience is available. IIa LOE C
7. For patients with VT/VF storm and significant SHD, implantation of a LV assist device (LVAD) or heart transplant evaluation should be considered and discussed early after the initial event. IIa LOE C

Table 7 Management of VT/VF storm

Intensive care unit admission
Device reprogramming
Correct underlying problems (ischaemia, electrolyte disturbances, pro-arrhythmic drugs)
Beta-blockade
Antiarrhythmic therapy
Sedation, intubation/deep sedation
Mechanical haemodynamic support (intra-aortic balloon pump)
Neuraxial modulation (thoracic epidural anesthesia, cardiac sympathetic denervation)
Catheter ablation (any time it is feasible)

Acute treatment is aimed to reduce VA episodes and maximize the chances of survival. For patients with an ICD, the detection criteria and therapies should be reprogrammed to minimize inappropriate shocks,⁷⁷ prevent shocks for potentially self-terminating VTs, and favour ATP therapies when feasible. Even though triggers of VT/VF storm are only rarely found,⁷⁰ patients should be screened for such reversible causes as electrolyte imbalances, ischaemia, acute valvular disease, and pro-arrhythmic drugs.

Antiarrhythmic drugs should be used for the acute phase to stabilize the patient.^{214,223} Beta-blockers have improved short-term outcome.²¹² Short-acting drugs, such as esmolol, might be considered in severely compromised patients, when an acute hypotensive effect is potentially likely.²²⁸ Even in patients already on oral beta-blocker therapy, intravenous administration of beta-blockers may help to reduce further ES episodes.²¹³ Beta-blockers can be combined with amiodarone to improve rhythm stability.²¹² Because intravenous lidocaine is relatively ineffective for termination of haemodynamically stable VTs and its prophylactic use has been associated with higher mortality,²¹⁴ this agent is a third choice drug for short-term treatment. In patients with severely impaired LV systolic function, the use of AADs should be weighed against the risks of worsening congestive heart failure and pro-arrhythmia.

Catheter ablation should be considered early after hospitalization (within 48 h) in patients with recurrent shocks despite acute treatment after the correction of metabolic, respiratory, and circulatory imbalances and a trial of AADs. Catheter ablation has been demonstrated to restore stable sinus rhythm maintenance during 7 days of in-hospital monitoring.¹⁰⁴ Complete elimination of VT inducibility during programmed electrical stimulation after ablation is associated with reduced VT recurrence during long-term follow-up; prevention of clinical VT inducibility has also been associated with a significant reduction of cardiac mortality.¹⁰⁴ Beneficial effects of catheter ablation on VT recurrences and survival are evident both in low- and high-risk patients.²¹¹ For patients who cannot be stabilized pharmacologically, neuraxial modulation, such as left cardiac sympathetic denervation (CSD) and spinal cord stimulation, may significantly reduce arrhythmias burden.^{212,215,216} This may allow stabilization before catheter ablation or LVAD implantation. Since VT/VF storm may be an indicator of poor prognosis,^{217–221} especially in patients with advanced SHD, early consultation with heart failure specialists should be considered to evaluate the advisability of mechanical cardiac support or cardiac transplantation.