VENTRICULAR TACHYCARDIA

CHI Formulary Development Project

مجلس الضمان الصحي
Council of Health Insurance

INDICATION UPDATE

ADDENDUM- December 2023

To the CHI Original Ventricular tachycardia Clinical Guidance- Issued January 2020

Contents

Related Documents

Related SOPs

- IDF-FR-P-02-01-IndicationsReview&IDFUpdates
- IDF-FR-P-05-01-UpdatedIndicationReview&IDFUpdates

Related WI:

- IDF-FR-WI-01-01SearchMethodologyGuideForNewIndications

List of Tables

List of Figures

Abbreviations

AAD	Anti-arrhythmic drug
ACE-I	Angiotensin-converting enzyme inhibitor
ALS	Advanced life support
ARVC	Arrhythmogenic right ventricular cardiomyopathy
ATP	Anti-tachycardia pacing
ATP	Anti-tachycardia pacing
AV	Atrioventricular
AVRT	AV re-entry tachycardia
BBR-VT	Bundle branch re-entrant ventricular tachycardia
CIED	Cardiac implantable electronic devices
CMR	Cardiac magnetic resonance
CPVT	Catecholaminergic polymorphic ventricular tachycardia
CPVT	Catecholaminergic polymorphic ventricular tachycardia
CRT	Cardia resynchronization therapy
DCM	Dilated cardiomyopathy
ECG	Electrocardiogram
ERP	Early repolarization pattern
ERS	Early repolarization syndrome
HCM	Hypertrophic cardiomyopathy
HNDCM	Hypokinetic non-dilated cardiomyopathy
LGE	Late gadolinium enhancement
LQTS	Long QT syndrome
LVNC	Left ventricular non-compaction
NSVT	Non-sustained ventricular tachycardia
OMT	Optimal medical treatment
PES	Programmed electrical stimulation
PVC	Premature ventricular complex

RVOT	Right ventricle outflow tract
SCD	Sudden cardiac death
SHD	Structural heart disease
SMVT	Sustained monomorphic ventricular tachycardia
SPVT	Sustained polymorphic ventricular tachycardia
TOF	Tetralogy of Fallot
VA	Ventricular arrythmia
VT	Ventricular tachycardia
WCD	Wearable cardioverter defibrillator

Executive Summary

Ventricular tachycardia (VT) is a broad complex tachycardia, characterized by the occurrence of three or more consecutive heartbeats at a rate exceeding 100 per minute, originating from the ventricular chambers. Ventricular tachycardia is a potentially life-threatening heart rhythm disturbance[1].

It can be categorized based on its duration, with **non-sustained** ventricular tachycardia referring to episodes lasting less than 30 seconds and not causing hemodynamic instability while **sustained** VT persists for more than 30 seconds or necessitates intervention within 30 seconds due to compromised hemodynamics. It can also be categorized into **monomorphic** and **polymorphic** ventricular tachycardia based on the appearance of the QRS complex. Monomorphic VT displays a consistent and unchanging QRS morphology with no variability from one beat to the next. In contrast, polymorphic VT exhibits variations in the shape of the QRS complex from beat to beat and can involve multiple QRS morphologies[1].

The typical signs and symptoms of VT include palpitations, dizziness, lightheadedness, chest pain, neck tightness, shortness of breath, and fainting. Complications may include cardiac arrest[2].

The treatment of VT involves several approaches including anti-arrhythmic medications, cardioversion, implantable cardioverter-defibrillator (ICD), catheter ablation and lifestyle modifications. The specific treatment approach depends on the type and severity of VT, as well as the patient's overall health and medical history[3].

The occurrence of ventricular tachycardia stands at around 54,000 per 100,000 for men and 55,000 per 100,000 for women who have hypertension, valvular heart disease, or cardiomyopathy but no coronary artery disease. In contrast, it is approximately 31,000 per 100,000 for men and 30,000 per 100,000 for women who do not have any cardiovascular disease[4].

According to results from registry of the Saudi Project for Assessment of Acute Coronary Syndrome (SPACE) published in 2012, 3.3% of the 5,055 patients with ACS that were enrolled were diagnosed with ventricular arrythmias (VA), including both tachycardia and fibrillation. Males were twice as likely to develop VA than females. Killip class > I and systolic blood pressure <90 mm Hg) were positively associated with VA. Those admitted with hyperlipidemia had a lower risk of developing VA[5].

CHI issued Ventricular Tachycardia clinical guidance after thorough review of renowned international and national clinical guidelines in January 2020. Updating clinical practice guidelines (CPGs) is a crucial process for maintaining the validity of recommendations.

This report functions as an addendum to the prior CHI Ventricular Tachycardia clinical guidance and seeks to offer guidance for the effective management of Ventricular Tachycardia. It provides an **update on the Ventricular Tachycardia Guidelines** for CHI Formulary with the ultimate objective of updating the IDF (CHI Drug Formulary) while addressing **the most updated best available clinical and economic evidence related to drug therapies.**

Main triggers for the update are summarized, by being **the update of the 2022** ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death and **the addition of new guidelines to the report** such as **2020** Canadian cardiovascular society/Canadian Heart rhythm society position statement on the management of ventricular tachycardia and fibrillation in patients with structural heart disease, the **2021** PACES expert consensus statement on the indications and management of cardiovascular implantable electronic devices in pediatric patients, the **2023** HRS expert consensus statement on the management of arrythmias during pregnancy, the **2019** HRS/EHRA/APHRS/LAHRS expert consensus statement on catheter ablation of ventricular arrythmias and the **2020** JCS/JHRS guideline on pharmacotherapy of cardiac arrythmias.

After carefully examining clinical guidelines and reviewing the SFDA drug list, one medication is no longer SFDA registered: quinidine sulfate. It is also worth noting that verapamil does not need "prior authorization (PA)" as a prescribing edit and this was removed.

All recommendations are well supported by reference guidelines, Grade of Recommendation (GoR), Level of Evidence (LoE) and Strength of Agreement (SoA) in all tables reflecting specific drug classes' role in Ventricular Tachycardia management.

Below is a table summarizing the major changes based on the different Ventricular Tachycardia guidelines used to issue this report:

Table 1. General Recommendations for the Management of Ventricular Tachycardia

Management of Ventricular Tachycardia	
General Recommendations	**Level of Evidence/Grade of Recommendation and Reference**
Direct current cardioversion is recommended as the first-line treatment for patients presenting with tolerated sustained monomorphic ventricular tachycardia (SMVT) provided that the anesthetic/sedation risk is low.	Class 1- ESC 2022 [6]

In patients presenting with a hemodynamically tolerated SMVT and known or suspected structural heart disease (SHD), intravenous procainamide/or amiodarone should be considered.	Class 2a- ESC 2022 [6]
In patients presenting with a hemodynamically tolerated SMVT in the absence of an established diagnosis, intravenous amiodarone may be considered.	Class 2b- ESC 2022 [6]
In patients with coronary artery disease (CAD) and recurrent, symptomatic SMVT, or implantable cardioverter defibrillator (ICD) shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating anti-arrhythmic drug (AAD) therapy.	Class 1a-ESC 2022 [6]
Beta-blockers or non-dihydropyridine calcium channel blockers (CCBs) are indicated in symptomatic patients with idiopathic VT/ premature ventricular complex (PVCs) from an origin other than the right ventricular outflow tract (RVOT) or the left fascicles.	Class 1- ESC 2022 [6]
Beta-blockers, non-dihydropyridine CCBs or flecainide should be considered when catheter ablation is not available, not desired, or is particularly risky in symptomatic patients with idiopathic VT/PVCs from the RVOT or the left fascicles.	Class 2a- ESC 2022 [6]
In pregnancy: Continuation of beta-blockers should be considered during pregnancy in women with ARVC. (Not the treatment for ARVC)	Class 2a- ESC 2022 [6]
In pregnancy: Oral metoprolol, propranolol, or verapamil should be considered for long-term management of idiopathic sustained VT during pregnancy. If possible, verapamil should be avoided in the third trimester of pregnancy,	Class 2a- ESC 2022 [6]
In pregnancy: Catheter ablation using non-fluoroscopic mapping systems should be considered, preferably after the first trimester, in women with highly symptomatic	Class 2a- ESC 2022 [6]

recurrent SMVT refractory or who are intolerant to AADs.	
The administration of I.V. amiodarone or lidocaine for acute treatment of patients with shock-refractory VT/VF (failure of at least 1 attempt at defibrillation) or patients with recurrent polymorphic VT/VF, unless there is a strong suspicion of torsade de pointes is recommended.	Strong Recommendation, Moderate-Quality Evidence- Canadian cardiovascular society 2020[7]
The use of b-blockade, preferably nonselective b-blockade, and I.V. amiodarone in patients with electrical storm in the setting of underlying structural heart disease (SHD) is recommended.	Strong Recommendation, Moderate-Quality Evidence-Canadian cardiovascular society 2020[7]
ICD implantation is indicated in patients with a diagnosis of catecholaminergic polymorphic ventricular tachycardia (CPVT) who experience cardiac arrest or arrhythmic syncope despite maximally tolerated beta-blocker plus flecainide and/or cardiac sympathetic denervation.	Class 1- LOE C-LD- PACES 2021[8]
In pregnant patients with CPVT, with symptoms ongoing despite beta-blocker therapy, such as recurrent syncope, VT, or cardiac arrest, intensification of therapy with either the addition of flecainide and/or a left cardiac sympathetic denervation, and/or an ICD is recommended as in the nonpregnant patient.	Class 1, LOE C-LD- HRS 2023[10]

At the end of the report, a **key recommendation synthesis section** is added highlighting the latest updates in **Ventricular tachycardia clinical and therapeutic management.**

Section 1.0 Summary of Reviewed Clinical Guidelines and Evidence

This section is divided into two parts: the first includes recommendations from **updated versions of guidelines** mentioned in the previous CHI Ventricular Tachycardia report, while the second includes **newly added guidelines** that have helped generate this report.

1.1 Revised Guidelines

This section contains the **updated versions** of the guidelines mentioned in the January 2020 CHI Report and the corresponding recommendations:

Table 2. Guidelines Requiring Revision

Guidelines Requiring Revision	
Old versions	**Updated versions**
ESC Guidelines for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death (**2015**)	**ESC** Guidelines for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death (**2022**)[6]
AHA/ACC/HRS Guideline for Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death (**2017**)	N/A*
American Heart Association Focused Update on Advanced Cardiovascular Life Support Use of Antiarrhythmic Drugs During and Immediately After Cardiac Arrest (**2018**)	N/A*

**: No updated version available: the existing version is the most recent one and no further updates or revisions have been made or released.*

1.1.1 European Society of Cardiology (ESC) Guidelines for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death (2022)

This guideline was developed by the task force for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death of the European Society of Cardiology (ESC). It presents an update of the 2015 ESC Guidelines for the management of patients with ventricular arrhythmias (VA) and the prevention of sudden cardiac death (SCD)[6]. For this report, the focus will be on ventricular tachycardia, and the main recommendations are detailed below.

Table 3. ESC 2022 Classes of Recommendations

Class	Definition	Recommendation
Class I	Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective	**Is recommended or is indicated**
Class II	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure	
Class IIa	Weight if evidence/opinion is in favor of usefulness/efficacy	**Should be considered**
Class IIb	Usefulness/efficacy is less well established by evidence/opinion	**May be considered**
Class III	Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful	**Is not recommended**

Table 4. ESC 2022 Levels of Evidence

Level of Evidence	Definition
A	Data derived from multiple randomized clinical trials or meta-analyses
B	Data derived from a single randomized clinical trial or large non-randomized studies
C	Consensus of the experts and/or small studies, retrospective studies, registries.

- Direct current (DC) cardioversion is recommended as the first-line treatment for patients presenting with tolerated sustained monomorphic ventricular tachycardia (SMVT) provided that the anesthetic/sedation risk is low. (Class 1)
- Implantation of a cardioverter defibrillator is only recommended in patients who have an expectation of good-quality survival > 1 year. (Class 1)
- In patients presenting with a hemodynamically tolerated SMVT and known or suspected structural heart disease (SHD), intravenous procainamide or amiodarone should be considered. (Class 2a)
- In patients presenting with a hemodynamically tolerated SMVT in the absence of an established diagnosis, intravenous amiodarone may be considered. (Class 2b)
- In patients with SMVT or sustained polymorphic ventricular tachycardia (SPVT)/ ventricular fibrillation (VF) triggered by a premature ventricular complex (PVC) with similar morphology and an indication for implantable cardioverter defibrillator (ICD), catheter ablation may be considered when an ICD is not available, contraindicated for concurrent medical reasons, or declined by the patient. (Class 2b)
- The wearable cardioverter defibrillator (WCD) may be considered in the early phase after myocardial infarction (MI) in selected patients. (Class 2b)
- In patients with coronary artery disease (CAD) and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating anti-arrhythmic drug (AAD) therapy. (Class 1a)
- ICD implantation should be considered in patients with CAD, left ventricular ejection fraction (LVEF) ≤ 40% despite ≥ 3 months of optimal medical therapy (OMT) and non-sustained ventricular tachycardia (NSVT), if they are inducible for SMVT by programmed electrical stimulation (PES). (Class 2a)
- In patients with CAD and hemodynamically well-tolerated SMVT and LVEF ≥ 40%, catheter ablation in experienced centers should be considered as an alternative to ICD therapy, provided that established endpoints have been reached. (Class 2a)
- Catheter ablation should be considered in patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite beta-blocker or amiodarone treatment. (Class 2a)

Idiopathic PVC/VT and PVC-induced cardiomyopathy

- Catheter ablation as first-line treatment is recommended for symptomatic idiopathic VT/PVCs from the right ventricular outflow tract (RVOT) or the left fascicles. (Class 1)
- Beta-blockers or non-dihydropyridine calcium channel blockers (CCBs) are indicated in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 1)
- In patients with PVCs/VT and a presentation not typical for an idiopathic origin, cardiac magnetic resonance (CMR) should be considered, despite a normal echocardiogram. (Class 2a)
- Beta-blockers, non-dihydropyridine CCBs or flecainide should be considered when catheter ablation is not available, not desired, or is particularly risky in symptomatic patients with idiopathic VT/PVCs from the RVOT or the left fascicles. (Class 2a)
- Catheter ablation or flecainide should be considered in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 2a)
- In patients with an unexplained reduced ejection fraction (EF) and a PVC burden of at least 10%, PVC-induced cardiomyopathy should be considered. (Class 2a)
- In patients with suspected PVC-induced cardiomyopathy, CMR should be considered. (Class 2a)
- In non-responders to cardiac resynchronization therapy (CRT) with frequent, predominately monomorphic PVCs limiting optimal biventricular pacing despite pharmacological therapy, catheter ablation or AADs should be considered. (Class 2a)
- Catheter ablation may be considered for idiopathic VT/PVCs in asymptomatic patients with repeatedly more than 20% of PVCs per day at follow-up. (Class 2b)
- Amiodarone as a first-line treatment is not recommended in patients with idiopathic VTs/PVCs. (Class 3)
- CMR with late gadolinium enhancement (LGE) should be considered in dilated cardiomyopathy (DCM)/ hypokinetic non-dilated cardiomyopathy (HNDCM) patients for assessing the etiology and the risk of ventricular arrhythmias (VA)/sudden cardiac death (SCD). (Class 2a)
- ICD implantation should be considered in patients with DCM/HNDCM and hemodynamically tolerated SMVT. (Class 2a)

- ICD implantation should be considered in symptomatic patients with definite arrhythmogenic right ventricular cardiomyopathy (ARVC), moderate right or left ventricular dysfunction, and either NSVT or inducibility of SMVT at programmed electrical stimulation (PES). (Class 2a)
- In arrhythmogenic right ventricular cardiomyopathy (ARVC) patients with indication for ICDs, a device with the capability of anti-tachycardia pacing (ATP) programming for SMVT up to high rates should be considered. (Class 2a)
- In patients with ARVC and symptoms highly suspicious for VA, PES may be considered for risk stratification. (Class 2b)
- In patients with HCM presenting with hemodynamically tolerated SMVT, ICD implantation should be considered. (Class 2a)
- In patients with HCM and recurrent, symptomatic VA, or recurrent symptomatic ICD therapy, AAD treatment should be considered. (Class 2a)
- Catheter ablation in specialized centers may be considered in selected patients with HCM and recurrent, symptomatic SMVT, or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated. (Class 2b)
- An ICD should be considered in patients with light-chain amyloidosis or transthyretin-associated cardiac amyloidosis and hemodynamically not-tolerated VT. (Class 2a)
- ICD implantation is recommended in patients with myotonic dystrophy and SMVT or aborted CA not caused by bundle branch re-entry (BBR)-VT. (Class 1)

Inflammatory diseases

- In patients with hemodynamically not-tolerated sustained VT or VF during the acute phase of myocarditis, ICD implantation before hospital discharge should be considered. (Class 2a)
- In post-myocarditis patients with recurrent, symptomatic VT, AAD treatment should be considered. (Class 2a)
- Catheter ablation, performed in specialized centers, should be considered in post-myocarditis patients with recurrent, symptomatic SMVT, or ICD shocks for SMVT in whom AADs are ineffective, not tolerated, or not desired. (Class 2a)
- In patients with hemodynamically tolerated SMVT occurring in the chronic phase of myocarditis, ICD implantation should be considered. (Class 2a)
- In patients with cardiac sarcoidosis who have an LVEF .35% but significant LGE at CMR after resolution of acute inflammation, ICD implantation should be considered. (Class 2a)

- In patients with cardiac sarcoidosis who have an LVEF 35–50% and minor LGE at CMR, after resolution of acute inflammation, PES for risk stratification should be considered. (Class 2a)
- In patients with cardiac sarcoidosis, LVEF 35–50%, and inducible SMVT at PES, ICD implantation should be considered. (Class 2a)
- In patients with cardiac sarcoidosis and recurrent, symptomatic VA, AAD treatment should be considered. (Class 2a)
- Amiodarone should be considered to reduce arrhythmia burden in patients with Chagas' cardiomyopathy who present with symptomatic PVCs or VT. (Class 2a)
- In patients with Chagas' cardiomyopathy and recurrent, symptomatic SMVT, or ICD shocks for SMVT in whom AADs are ineffective, contraindicated, or not tolerated, catheter ablation in specialized centers should be considered. (Class 2a)
- In patients with Chagas' cardiomyopathy and symptomatic VT in whom AADs (amiodarone and beta-blockers) are ineffective or not tolerated, ICD implantation may be considered. (Class 2b)
- In patients with hemodynamically well-tolerated SMVT occurring in the chronic phase of myocarditis, preserved LV function and a limited scar amenable to ablation, catheter ablation may be considered as an alternative to ICD therapy, after discussion with the patient and provided that established endpoints have been reached. (Class 2b)
- Catheter ablation, in specialized centers, may be considered in cardiac sarcoidosis ICD recipients with recurrent, symptomatic SMVT, or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated. (Class 2b)
- In patients with repaired tetralogy of Fallot (TOF) with a preserved biventricular function and symptomatic SMVT, catheter ablation or concomitant surgical ablation performed in specialized centers may be considered as an alternative to ICD therapy. (Class 2b)
- In patients with hemodynamically not-tolerated SMVT occurring in the chronic phase of myocarditis, ICD implantation is recommended. (Class 1)

Idiopathic VF

- Isoproterenol infusion or verapamil for acute treatment of an electrical storm or recurrent ICD discharges should be considered in idiopathic VF. (Class 2a)

Long QT syndrome (LQTS)

- Beta-blockers, ideally non-selective beta-blockers (nadolol [preferred] or propranolol), are recommended in long QT syndrome (LQTS) patients with documented QT interval prolongation, to reduce risk of arrhythmic events. (Class 1)
- Mexiletine is indicated in LQT3 patients with a prolonged QT interval. (Class 1)
- ICD implantation may be considered in asymptomatic LQTS patients with high-risk profile (according to the 1-2-3 LQTS Risk calculator) in addition to genotype-specific medical therapies (mexiletine in LQT3 patients). (Class 2b)
- Routine diagnostic testing with epinephrine challenge is not recommended in LQTS. (Class 3)

Early repolarization syndrome (ERS)

- It is recommended that the early repolarization syndrome (ERS) is diagnosed in a patient resuscitated from unexplained VF/PVT in the presence of early repolarization pattern (ERP). (Class 1)
- Quinidine in addition to an ICD should be considered for recurrent VF in ERS patients.
- PVC ablation should be considered in ERS patients with recurrent VF episodes triggered by a similar PVC non-responsive to medical treatment. (Class 2a)

Catecholaminergic polymorphic ventricular tachycardia (CPVT)

- Beta-blockers, ideally non-selective (nadolol or propranolol) are recommended in all patients with a clinical diagnosis of CPVT. (Class 1)
- Epinephrine or isoproterenol challenge may be considered for the diagnosis of CPVT when an exercise test is not possible. (Class 2b)
- LCSD should be considered in patients with diagnosis of CPVT when the combination of beta-blockers and flecainide at therapeutic dosage are either not effective, not tolerated, or contraindicated. (Class 2a)

Selected populations

- Continuation of beta-blockers should be considered during pregnancy in women with ARVC. (Class 2a)
- Oral metoprolol, propranolol, or verapamil should be considered for long-term management of idiopathic sustained VT during pregnancy. (Class 2a)

- Catheter ablation using non-fluoroscopic mapping systems should be considered, preferably after the first trimester, in women with highly symptomatic recurrent SMVT refractory or who are intolerant to AADs. (Class 2a)**.**

1.2 Additional Guidelines

This part includes the added guidelines to the previous CHI ventricular tachycardia report, along with their recommendations.

Table 5. List of Additional Guidelines

Additional Guidelines
Canadian Cardiovascular Society/Canadian Heart Rhythm Society Position Statement on the Management of Ventricular Tachycardia and Fibrillation in Patients with Structural Heart Disease (**2020**)[7]
Pediatric and Congenital Electrophysiology Society (PACES) Expert Consensus Statement on the Indications and Management of Cardiovascular Implantable Electronic Devices in Pediatric Patients (**2021**)[8]
Heart Rhythm Society (HRS) Expert Consensus Statement on the Management of Arrhythmias During Pregnancy (**2023**)[9]
HRS/EHRA/APHRS/LAHRS Expert Consensus Statement on Catheter Ablation of Ventricular Arrhythmias (2019)[10]
Japanese Circulation Society (JCS)/Japanese Heart Rhythm Society (JHRS) Guideline on Pharmacotherapy of Cardiac Arrhythmias (**2020**)[11]

1.2.1 Canadian Cardiovascular Society/Canadian Heart Rhythm Society Position Statement on the Management of Ventricular Tachycardia and Fibrillation in Patients with Structural Heart Disease (2020)

This Canadian Cardiovascular Society position statement is focused on the management of sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) that occurs in patients with structural heart disease (SHD), including previous myocardial infarction, dilated cardiomyopathy, and other forms of nonischemic cardiomyopathy. This patient population is rapidly increasing because of advances in care and improved overall survival of patients with all forms of SHD[7]. For this report, the focus will be on ventricular tachycardia, and the main recommendations are detailed below. The recommendations were developed using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) standards with strength of recommendations classified as “strong” or “conditional”.

- All patients presenting with VT/VF should undergo a comprehensive initial evaluation including a detailed history, physical examination, laboratory investigations, ECG, ICD interrogation (if present) and transthoracic echocardiography (Strong Recommendation, Low-Quality Evidence).
- CMR imaging is recommended to be performed in patients who present with VT/VF when the initial evaluation has failed to establish the etiology of the underlying heart disease (Strong Recommendation, Moderate-Quality Evidence).
- The administration of I.V. amiodarone or lidocaine for acute treatment of patients with shock-refractory VT/VF (failure of at least 1 attempt at defibrillation) or patients with recurrent polymorphic VT/VF, unless there is a strong suspicion of torsade de pointes is recommended. (Strong Recommendation, Moderate-Quality Evidence).
- The use of beta-blockade, preferably nonselective beta-blockade, and I.V. amiodarone in patients with electrical storm in the setting of underlying SHD is recommended. (Strong Recommendation, Moderate-Quality Evidence).
- Electrical cardioversion or I.V. procainamide for the acute treatment of stable monomorphic VT in patients with SHD is recommended. (Strong Recommendation, Moderate-Quality Evidence).
- In patients with SHD and new or recurrent VT/VF, the guideline recommends:
    1. optimizing beta-blocker dose in all patients
    2. optimizing ICD programming
    3. consideration of initiation of additional suppressive therapy (either class III AAD therapy or catheter ablation), particularly in patients with VT/VF resulting in ICD shock(s), in those with a high burden of VT/VF, and in those with severe symptoms/hemodynamic compromise or psychosocial distress (Strong Recommendation, Low-Quality Evidence).
- The guideline recommends optimizing beta-blocker dose and using additional suppressive therapy (amiodarone or catheter ablation), in patients with SHD who present with electrical storm (Strong Recommendation, Moderate Quality Evidence).
- Beta-blocker therapy, titrated to a maximally tolerated dose (optimized dose), in patients with SHD with VT/VF is recommended (Strong Recommendation, Moderate-Quality Evidence).
- If AAD therapy is chosen for suppressive therapy, the guideline recommends that either sotalol or amiodarone be used as first-line AAD therapy for

suppression of VT/VF in patients with SHD (Strong Recommendation, High quality of evidence).

- Catheter ablation can be considered, in selected patients, as first-line suppressive therapy, in addition to b-blocker therapy, for patients with ischemic cardiomyopathy (previous MI) and monomorphic VT (Conditional Recommendation, Low-Quality Evidence).
- Catheter ablation of monomorphic VT in patients with ischemic cardiomyopathy (previous MI) in whom treatment with sotalol or amiodarone has been ineffective is recommended. (Strong Recommendation, High-Quality Evidence).
- Catheter ablation of monomorphic VT in patients with nonischemic cardiomyopathy in whom treatment with sotalol or amiodarone has been ineffective is recommended. (Strong Recommendation, Low-Quality Evidence).
- Mexiletine (given in addition to amiodarone) or dofetilide can be used in patients with SHD and refractory VT/VF who are not candidates or in whom therapy with sotalol, amiodarone, or catheter ablation has failed (Conditional Recommendation, Low-Quality Evidence)
- Bipolar radiofrequency ablation, extendable/retractable radiofrequency needle ablation, stereotactic ablative radiotherapy, and sympathectomy may be considered for treatment of VT/VF after failure of one or more standard ablation procedures and after failure of amiodarone therapy (Conditional Recommendation, Low-Quality Evidence).
- In patients with VT/VF, the guideline recommends ongoing incorporation of patient values and preferences in goals of care discussions, including ICD tachycardia therapy deactivation or ICD replacement with a pacemaker, particularly at times of ICD generator replacement or changes in clinical status (Strong Recommendation, Low-Quality Evidence).

1.2.2 Pediatric and Congenital Electrophysiology Society (PACES) Expert Consensus Statement on the Indications and Management of Cardiovascular Implantable Electronic Devices in Pediatric Patients (2021)

This consensus statement was developed in collaboration with and endorsed by the Heart Rhythm Society (HRS), the American College of Cardiology (ACC), the American Heart Association (AHA), and the Association for European Pediatric and Congenital Cardiology (AEPC). Endorsed by the Asia Pacific Heart Rhythm Society (APHRS), the Indian Heart Rhythm Society (IHRS), and the Latin American Heart Rhythm Society (LAHRS). It has been developed to update and further delineate

indications and management of cardiovascular implantable electronic devices (CIEDs) in pediatric patients, defined as ≤21 years of age, and is intended to focus primarily on the indications for CIEDs in the setting of specific disease categories[8].

Table 6. PACES 2021 Guidelines Classes of Recommendations

Class 1	**Class 2a**	**Class 2b**	**Class 3**
Benefit >>> Risk	Benefit >> risk	Benefit ≥ Risk	Risk ≥ Benefit
Procedure/ treatment SHOULD be performed/ is recommended	IT IS REASONABLE to perform the procedure/ treatment	Procedure/ treatment MAY BE CONSIDERED/ effectiveness is uncertain	Procedure should NOT be performed/ IS NOT HELPFUL/ MAY BE HARMFUL

Table 7. PACES 2021 Guidelines Levels of Evidence

B-NR	Evidence from nonrandomized studies, observational studies, or registry studies
C-LD	Very limited evidence from observational studies or case series reports
C-EO	Consensus expert opinion, case studies, or standard of care

The main recommendations related to ventricular tachycardia are summarized below:

- ICD implantation is indicated in patients with a diagnosis of CPVT who experience cardiac arrest or arrhythmic syncope despite maximally tolerated beta-blocker plus flecainide and/or cardiac sympathetic denervation. (Class 1- LOE C-LD)
- ICD implantation is reasonable in combination with pharmacologic therapy with or without cardiac sympathetic denervation when aborted SCA is the initial presentation of CPVT. Pharmacologic therapy and/or cardiac sympathetic denervation without ICD may be considered as an alternative. (Class 2a- LOE C-LD)
- ICD implantation may be considered in CPVT patients with polymorphic/bidirectional VT despite optimal pharmacologic therapy with or without cardiac sympathetic denervation. (Class 2b-LOE C-LD)
- ICD implantation is not indicated in asymptomatic patients with a diagnosis of CPVT. (Class 3- LOE C-EO)

1.2.3 Heart Rhythm Society (HRS) Expert Consensus Statement on the Management of Arrhythmias During Pregnancy (2023)

This international multidisciplinary expert consensus statement is intended to provide comprehensive guidance that can be referenced at the point of care to cardiac electrophysiologists, cardiologists, and other health care professionals, on the management of cardiac arrhythmias in pregnant patients and in fetuses. This document covers general concepts related to arrhythmias, including both brady- and tachyarrhythmias, in both the patient and the fetus during pregnancy. It was developed in collaboration with and endorsed by the American College of Cardiology (ACC), the American College of Obstetricians and Gynecologists (ACOG), the American Heart Association (AHA), the Asia Pacific Heart Rhythm Society (APHRS), the European Heart Rhythm Association (EHRA), the Latin American Heart Rhythm Society (LAHRS), the Pediatric and Congenital Electrophysiology Society (PACES), and the Society for Maternal-Fetal Medicine (SMFM)[9]. For this report, only recommendations related to ventricular tachycardia are included:

- In pregnant patients with CPVT, pharmacological therapy as in the nonpregnant patient should be continued throughout pregnancy and the postpartum period, including during delivery and breastfeeding. (COR 1, LOE C-LD)
- In pregnant patients with CPVT, with symptoms ongoing despite beta-blocker therapy, such as recurrent syncope, VT, or cardiac arrest, intensification of therapy with either the addition of flecainide and/or a left cardiac sympathetic denervation, and/or an ICD is recommended as in the nonpregnant patient. (Class 1, LOE C-LD)
- In pregnant patients with CPVT who are genotype-positive and phenotype-negative, use of beta-blockers during pregnancy and postpartum is reasonable. (Class 2a, LOE C-LD)

1.2.4 HRS/EHRA/APHRS/LAHRS Expert Consensus Statement on Catheter Ablation of Ventricular Arrhythmias (2019)

This guideline is an update on the 2009 EHRA/HRS Expert Consensus on Catheter Ablation of Ventricular Arrhythmias[10]. The main recommendations are summarized below:

- In patients with bundle branch reentrant VT, catheter ablation is useful for reducing the risk of recurrent VT. (COR 1, LOE B-NR)

- In patients with idiopathic left fascicular reentrant VT for whom medications are ineffective, not tolerated, or not the patient's preference, catheter ablation is useful. (COR 1, LOE B-NR)
- In larger pediatric patients (>= 15 kg) with idiopathic left fascicular reentrant VT in whom medical treatment is ineffective or not tolerated, catheter ablation is useful. (COR 1, LOE B-NR)
- In patients with focal fascicular VT with or without SHD, catheter ablation is useful. (COR 1, LOE B-NR)
- In patients with postinfarction reentrant Purkinje fiber-mediated VT, catheter ablation is useful. (COR 1, LOE B-NR)

1.2.5 Japanese Circulation Society (JCS)/Japanese Heart Rhythm Society (JHRS) Guideline on Pharmacotherapy of Cardiac Arrhythmias (2020)

This revised version of "2020 JCS/JHRS Guideline on Pharmacotherapy of Cardiac Arrhythmias" was prepared as a joint guideline by the JCS and the Japanese Heart Rhythm Society (JHRS)[11]. The main recommendations on the management of ventricular tachycardia are summarized below.

Table 8. JCS/JHRS 2020 Guideline Classes of Recommendation

Class 1	Evidence and/or general agreement that a given procedure or treatment is useful and effective
Class 2	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given procedure or treatment
Class 2a	Weight of evidence/opinion is in favor of usefulness/efficacy
Class 2b	Usefulness/efficacy is less well established by evidence/ opinion
Class 3	Evidence or general agreement that the given procedure or treatment is not useful/effective, and in some cases may be harmful

Table 9. JCS/JHRS 2020 Levels of Evidence

Level A	Data derived from multiple randomized clinical trials or meta-analyses
Level B	Data derived from a single randomized clinical trial or large-scale nonrandomized studies
Level C	Consensus of opinion of the experts and/or small-sized clinical studies, retrospective studies, and registries

Table 10. MINDS Grades of Recommendation

Grade A	Strongly recommended and supported by strong evidence
Grade B	Recommended with moderately strong supporting evidence
Grade C1	Recommended despite no strong supporting evidence
Grade C2	Not recommended because of the absence of strong supporting evidence
Grade D	Not recommended as evidence indicates that the treatment is ineffective or even harmful

Table 11. MINDS Levels of Evidence

1	Systematic review/meta-analysis of randomized controlled trials
2	One or more randomized controlled trials
3	Nonrandomized controlled trials
4a	Analytical epidemiological studies (cohort studies)
4b	Analytical epidemiological studies (case–control studies and cross-sectional studies)
5	Descriptive studies (case reports and case series)
6	Not based on patient data, or based on opinions from a specialist committee or individual specialists

Recommendations and Levels of Evidence for **Treatment of Idiopathic VT**

- Use of β-blocker for the symptomatic VT without structural heart disease and/or inherited arrhythmia (COR 2a, LOE C, GOR (MINDS) C1, LOE (MINDS) 4a)
- Use of non-dihydropyridine calcium antagonist instead of β-blocker for VT without organic heart disease (COR 2a, LOE C, GOR (MINDS) C1, LOE (MINDS) 4a)
- Use of Class I antiarrhythmic drugs for calcium antagonist- and β-blocker-refractory VT (COR 2b, LOE C, GOR (MINDS) C1, LOE (MINDS) 4a)

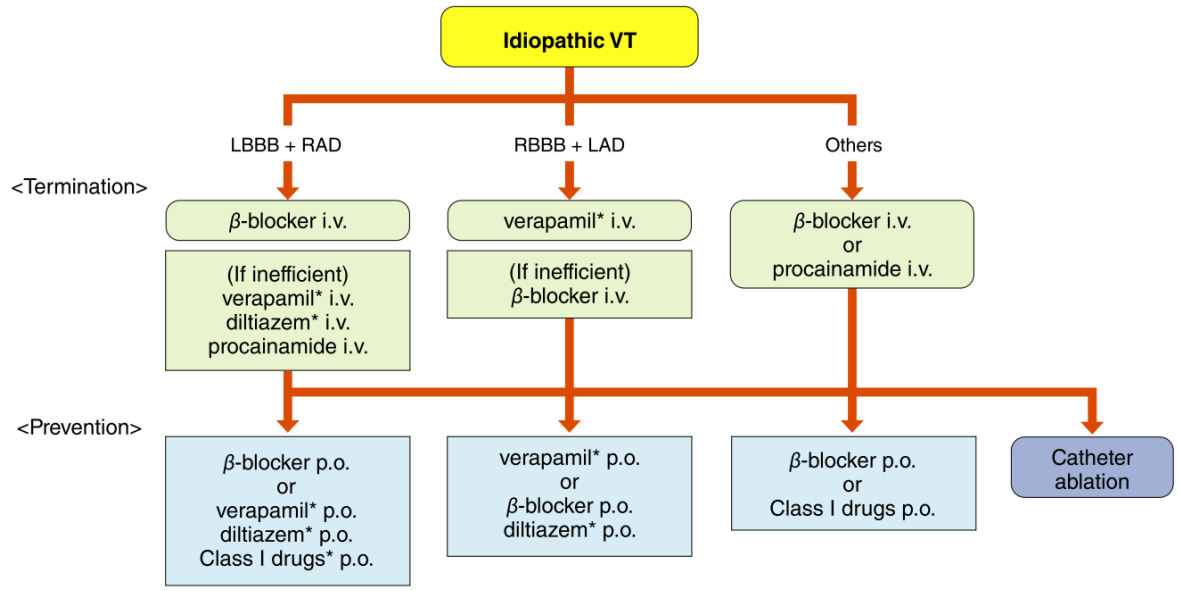

Figure 1. *Choice of antiarrhythmic drugs based on ECG morphology of ventricular tachycardia. Retrieved from the JCS/JHRS 2020 guideline.*

Recommendations and Levels of Evidence for **Therapy for VT Associated with Organic Heart Disease:**

- Immediate direct-current defibrillation in the patients with sustained hemodynamically unstable VT (COR 1, LOE B, GOR (MINDS) A, LOE (MINDS) 3)
- Use of ICD for recurrent VT and prevention of sudden cardiac death (COR 1, LOE A, GOR (MINDS) 1, LOE (MINDS) 1)
- Intravenous administration of amiodarone or nifekalant for resuscitation in patients with sustained or recurrent hemodynamically unstable VT after direct-current defibrillation (COR 2A, LOE A, GOR (MINDS) B, LOE (MINDS) 2)
- Intravenous administration of procainamide for termination of hemodynamically stable monomorphic sustained VT (COR 2A, LOE A, GOR (MINDS) B, LOE (MINDS) 2)
- Use of oral amiodarone or sotalol for recurrence of VT (COR 2A, LOE A, GOR (MINDS) A, LOE (MINDS) 2)
- Intravenous administration of amiodarone for termination of hemodynamically stable polymorphic sustained VT (COR 2B, LOE A, GOR (MINDS) C1, LOE (MINDS) 2)

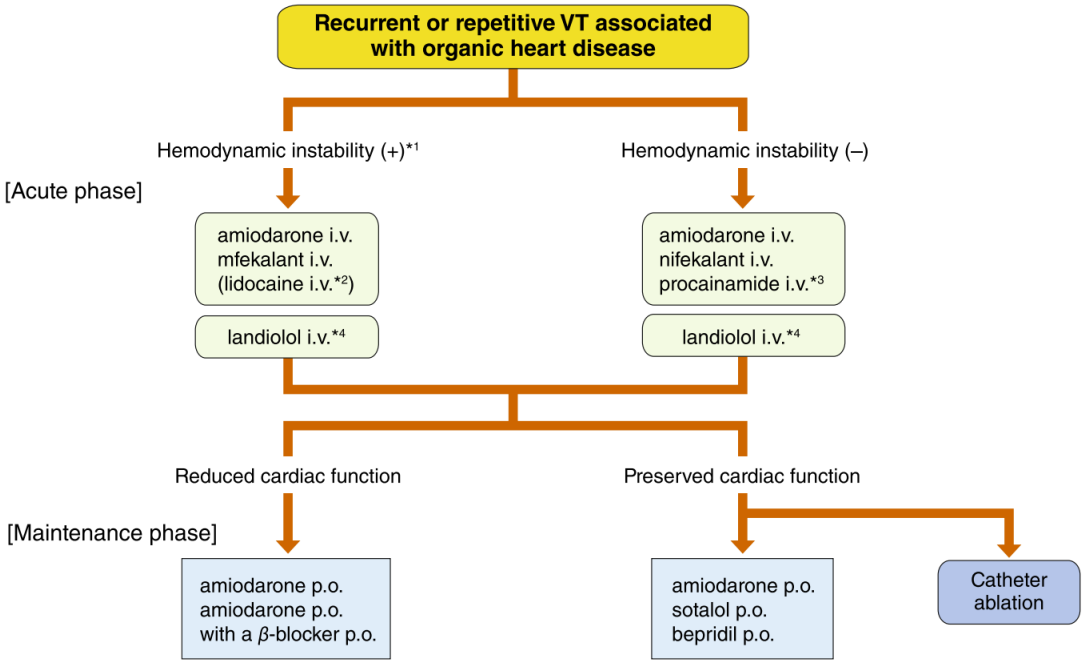

Figure 2. *Drug selection for the purpose of termination and prevention of sustained VT associated with organic heart disease. Retrieved from the JCS/JHRS 2020 guideline.*

Recommendations and Levels of Evidence for **Pharmacological Therapy for PMVT and Short-Coupled TdP**

- Intravenous administration of β-blocker for the bail-out of PMVT storm when it occurs during the subacute phase ≥72 h after the onset of ACS (COR 2a, LOE B, GOR (MINDS) B, LOE (MINDS 2)
- Use of prophylactic β-blocker for prevention of short-coupled TdP if triggered by PVC arising from the RVOT) COR 2a, LOE C, GOR (MINDS) C1, LOE (MINDS) 5)
- Use of verapamil for prophylaxis of short-coupled TdP in patients without any ischemic or structural disease (COR 2B, LOE C, GOR (MINDS) C1, LOE (MINDS) 5)
- Use of quinidine for prophylaxis of short-coupled TdP in patients with any ischemic or structural disease (COR 2B, LOE C, GOR (MINDS) C1, LOE (MINDS) 5)

Section 2.0 Drug Therapy

This section comprises three subsections: the first contains the newly recommended drugs SFDA registered, the second covers drug modifications, and the third outlines the drugs that have been withdrawn from the market.

2.1 Additions

After January 2020, there have been no new drugs that have received FDA and EMA approval and have been registered by the SFDA for the treatment of ventricular tachycardia.

2.2 Modifications

*Please refer to **section 2.5.7** in the previous report.*

Verapamil does not need prior authorization and therefore this prescribing edit was removed.

2.3 Delisting

Table 12. Delisted Drugs

Delisted medications	Reason	Medication status	Alternative
Quinidine	Withdrawn form SFDA	Antiarrhythmics are not first line to be used in ventricular tachycardia: they come after beta blockers and non DHP CCBs. If AADs, are to be used we prefer class 3 antiarrhythmics, specifically amiodarone as a first option. If quinidine is to be used, we have different alternatives with same pharmacological class.	Quinidine is a class **1a** antiarrhythmic medication: other alternatives pertaining to the same class: **flecainide**, **lidocaine** are SFDA registered and can be used in case of ventricular tachycardia

Section 3.0 Key Recommendations Synthesis

- In patients with SHD and new or recurrent VT/VF, it is recommended to:
    1. optimizing b-blocker dose in all patients
    2. optimizing ICD programming
    3. consideration of initiation of additional suppressive therapy (either class III AAD therapy or catheter ablation), particularly in patients with VT/VF resulting in ICD shock(s), in those with a high burden of VT/VF, and in those with severe symptoms/hemodynamic compromise or psychosocial distress (Strong Recommendation, Low-Quality Evidence)[7].
- In patients presenting with a hemodynamically tolerated SMVT in the absence of an established diagnosis, intravenous amiodarone may be considered. (Class 2b)[6]
- In patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy. (Class 1a)[6]

Idiopathic PVC/VT and PVC-induced cardiomyopathy:

- Catheter ablation as first-line treatment is recommended for symptomatic idiopathic VT/PVCs from the RVOT or the left fascicles. (Class 1)[6]
- Beta-blockers or non-dihydropyridine CCBs are indicated in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 1)[6]
- Beta-blockers, non-dihydropyridine CCBs or flecainide should be considered when catheter ablation is not available, not desired, or is particularly risky in symptomatic patients with idiopathic VT/PVCs from the RVOT or the left fascicles. (Class 2a)[6]
- Catheter ablation or flecainide should be considered in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 2a)[6]
- Amiodarone as a first-line treatment is not recommended in patients with idiopathic VTs/PVCs. (Class 3)[6]
- In patients with hemodynamically not-tolerated sustained VT or VF during the acute phase of myocarditis, ICD implantation before hospital discharge should be considered. (Class 2a)[6]

- In post-myocarditis patients with recurrent, symptomatic VT, AAD treatment should be considered. (Class 2a)[6]

CPVT

- Beta-blockers, ideally non-selective (nadolol or propranolol) are recommended in all patients with a clinical diagnosis of CPVT. (Class 1)[6]
- Beta-blocker therapy, titrated to a maximally tolerated dose (optimized dose), in patients with SHD with VT/VF is recommended (Strong Recommendation, Moderate-Quality Evidence).[7]
- In pregnant patients with CPVT, pharmacological therapy as in the nonpregnant patient should be continued throughout pregnancy and the postpartum period, including during delivery and breastfeeding. (COR 1, LOE C-LD)[9]
- In pregnant patients with CPVT, with symptoms ongoing despite beta-blocker therapy, such as recurrent syncope, VT, or cardiac arrest, intensification of therapy with either the addition of flecainide and/or a left cardiac sympathetic denervation, and/or an ICD is recommended as in the nonpregnant patient. (Class 1, LOE C-LD)[9]

Section 4.0 Conclusion

This report serves as **an annex to the previous CHI Ventricular tachycardia report** and aims to provide recommendations to aid in the management of Ventricular tachycardia. It is important to note that these recommendations should be utilized to support clinical decision-making and not replace it in the management of individual patients with ventricular tachycardia. Health professionals are expected to consider this guidance alongside the specific needs, preferences, and values of their patients when exercising their judgment.

Section 5.0 References

1. Ventricular Tachycardia - StatPearls - NCBI Bookshelf. Accessed October 27, 2023. https://www.ncbi.nlm.nih.gov/books/NBK532954/
2. Ventricular Tachycardia (VT) | Cedars-Sinai. Accessed October 27, 2023. https://www.cedars-sinai.org/health-library/diseases-and-conditions/v/ventricular-tachycardia-1.html
3. Ventricular tachycardia - Diagnosis and treatment - Mayo Clinic. Accessed October 27, 2023. https://www.mayoclinic.org/diseases-conditions/ventricular-tachycardia/diagnosis-treatment/drc-20355144
4. Ventricular tachycardia epidemiology and demographics - wikidoc. Accessed October 27, 2023. https://www.wikidoc.org/index.php/Ventricular_tachycardia_epidemiology_and_demographics
5. Hersi AS, Alhabib KF, AlFaleh HF, et al. Incidence of ventricular arrhythmia and associated patient outcomes in hospitalized acute coronary syndrome patients in Saudi Arabia: findings from the registry of the Saudi Project for Assessment of Acute Coronary Syndrome (SPACE). *Ann Saudi Med*. 2012;32(4):372-377. doi:10.5144/0256-4947.2012.372
6. Zeppenfeld K, Tfelt-Hansen J, De Riva M, et al. 2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. *Eur Heart J*. 2022;43(40):3997-4126. doi:10.1093/eurheartj/ehac262
7. Deyell MW, AbdelWahab A, Angaran P, et al. 2020 Canadian Cardiovascular Society/Canadian Heart Rhythm Society Position Statement on the Management of Ventricular Tachycardia and Fibrillation in Patients With Structural Heart Disease. *Canadian Journal of Cardiology*. 2020;36(6):822-836. doi:10.1016/j.cjca.2020.04.004
8. Shah MJ, Silka MJ, Silva JNA, et al. 2021 PACES Expert Consensus Statement on the Indications and Management of Cardiovascular Implantable Electronic Devices in Pediatric Patients. *Heart Rhythm*. 2021;18(11):1888-1924. doi:10.1016/j.hrthm.2021.07.038
9. Joglar JA, Kapa S, Saarel E V., et al. 2023 HRS expert consensus statement on the management of arrhythmias during pregnancy. *Heart Rhythm*. Published online October 2023. doi:10.1016/j.hrthm.2023.05.017
10. Cronin EM, Bogun FM, Maury P, et al. 2019 HRS/EHRA/APHRS/LAHRS expert consensus statement on catheter ablation of ventricular arrhythmias. *Heart Rhythm*. 2020;17(1):e2-e154. doi:10.1016/j.hrthm.2019.03.002

11. Ono K, Iwasaki Y ki, Akao M, et al. JCS/JHRS 2020 Guideline on Pharmacotherapy of Cardiac Arrhythmias. *J Arrhythm*. 2022;38(6):833-973. doi:10.1002/joa3.12714

Section 6.0 Appendices

Appendix A. Prescribing Edits Definition

I. Prescribing Edits

Some covered drugs may have additional requirements, rules, or limits on coverage. These requirements and limits may include:

Prescribing edits Tools	Description
AGE (Age):	Coverage may depend on patient age
CU (Concurrent Use):	Coverage may depend upon concurrent use of another drug
G (Gender):	Coverage may depend on patient gender
MD (Physician Specialty):	Coverage may depend on prescribing physician's specialty or board certification
PA (Prior Authorization):	Requires specific physician request process
QL (Quantity Limits):	Coverage may be limited to specific quantities per prescription and/or time
ST (Step Therapy):	Coverage may depend on previous use of another drug
EU (Emergency Use only):	This drug status on Formulary is only for emergency use
PE (Protocol Edit):	Use of drug is dependent on protocol combination, doses, and sequence of therapy

Appendix B. Ventricular Tachycardia Scope

Section	Rationale/Updates
2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death[6]	• DC cardioversion is recommended as the first-line treatment for patients presenting with tolerated SMVT provided that the anaesthetic/sedation risk is low. (Class 1) • Implantation of a cardioverter defibrillator is only recommended in patients who have an expectation of good-quality survival >1 year. (Class 1) • In patients presenting with a hemodynamically tolerated SMVT and known or suspected SHD, intravenous procainamide should be considered. (Class 2a) • In patients presenting with a hemodynamically tolerated SMVT in the absence of an established diagnosis, intravenous amiodarone may be considered. (Class 2b) • In patients with SMVT or SPVT/VF triggered by a PVC with similar morphology and an indication for ICD, catheter ablation may be considered when an ICD is not available, contraindicated for concurrent medical reasons, or declined by the patient. (Class 2b) • The WCD may be considered in the early phase after MI in selected patients. (Class 2b) • In patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy. (Class 1a) • ICD implantation should be considered in patients with CAD, LVEF ≤40% despite ≥3 months of OMT and NSVT, if they are inducible for SMVT by PES. (Class 2a) • In patients with CAD and hemodynamically well-tolerated SMVT and LVEF ≥40%, catheter ablation in experienced centers should be considered as an alternative to ICD therapy, provided that established endpoints have been reached. (Class 2a)

	• Catheter ablation should be considered in patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite beta-blocker or sotalol treatment. (Class 2a) • **Idiopathic PVC/VT and PVC-induced cardiomyopathy:** • Catheter ablation as first-line treatment is recommended for symptomatic idiopathic VT/PVCs from the RVOT or the left fascicles. (Class 1) • Beta-blockers or non-dihydropyridine CCBs are indicated in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 1) • In patients with PVCs/VT and a presentation not typical for an idiopathic origin, CMR should be considered, despite a normal echocardiogram. (Class 2a) • Beta-blockers, non-dihydropyridine CCBs or flecainide should be considered when catheter ablation is not available, not desired, or is particularly risky in symptomatic patients with idiopathic VT/PVCs from the RVOT or the left fascicles. (Class 2a) • Catheter ablation or flecainide should be considered in symptomatic patients with idiopathic VT/PVCs from an origin other than the RVOT or the left fascicles. (Class 2a) • In patients with an unexplained reduced EF and a PVC burden of at least 10%, PVC-induced cardiomyopathy should be considered. (Class 2a) • In patients with suspected PVC-induced cardiomyopathy, CMR should be considered. (Class 2a) • In non-responders to CRT with frequent, predominately monomorphic PVCs limiting optimal biventricular pacing despite pharmacological therapy, catheter ablation or AADs should be considered. (Class 2a) • Catheter ablation may be considered for idiopathic VT/PVCs in asymptomatic patients with repeatedly more than 20% of PVCs per day at follow-up. (Class 2b) • Amiodarone as a first-line treatment is not recommended in patients with idiopathic VTs/PVCs. (Class 3)

	• CMR with LGE should be considered in DCM/HNDCM patients for assessing the etiology and the risk of VA/SCD. (Class 2a) • ICD implantation should be considered in patients with DCM/ HNDCM and hemodynamically tolerated SMVT. (Class 2a) • ICD implantation should be considered in symptomatic patients with definite ARVC, moderate right or left ventricular dysfunction, and either NSVT or inducibility of SMVT at PES. (Class 2a) • In ARVC patients with indication for ICDs, a device with the capability of ATP programming for SMVT up to high rates should be considered. (Class 2a) • In patients with ARVC and symptoms highly suspicious for VA, PES may be considered for risk stratification. (Class 2b) • In patients with HCM presenting with hemodynamically tolerated SMVT, ICD implantation should be considered. (Class 2a) • In patients with HCM and recurrent, symptomatic VA, or recurrent symptomatic ICD therapy, AAD treatment should be considered. (Class 2a) • Catheter ablation in specialized centers may be considered in selected patients with HCM and recurrent, symptomatic SMVT, or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated. (Class 2b) • An ICD should be considered in patients with light-chain amyloidosis or transthyretin-associated cardiac amyloidosis and hemodynamically not-tolerated VT. (Class 2a) • ICD implantation is recommended in patients with myotonic dystrophy and SMVT or aborted CA not caused by BBR-VT. (Class 1) • **Inflammatory diseases** • In patients with hemodynamically not-tolerated sustained VT or VF during the acute phase of myocarditis, ICD implantation before hospital discharge should be considered. (Class 2a) • In post-myocarditis patients with recurrent, symptomatic VT, AAD treatment should be considered. (Class 2a)

	• Catheter ablation, performed in specialized centers, should be considered in post-myocarditis patients with recurrent, symptomatic SMVT, or ICD shocks for SMVT in whom AADs are ineffective, not tolerated, or not desired. (Class 2a) • In patients with hemodynamically tolerated SMVT occurring in the chronic phase of myocarditis, ICD implantation should be considered. (Class 2a) • In patients with cardiac sarcoidosis who have an LVEF .35% but significant LGE at CMR after resolution of acute inflammation, ICD implantation should be considered. (Class 2a) • In patients with cardiac sarcoidosis who have an LVEF 35–50% and minor LGE at CMR, after resolution of acute inflammation, PES for risk stratification should be considered. (Class 2a) • In patients with cardiac sarcoidosis, LVEF 35–50%, and inducible SMVT at PES, ICD implantation should be considered. (Class 2a) • In patients with cardiac sarcoidosis and recurrent, symptomatic VA, AAD treatment should be considered. (Class 2a) • Amiodarone should be considered to reduce arrhythmia burden in patients with Chagas' cardiomyopathy who present with symptomatic PVCs or VT. (Class 2a) • In patients with Chagas' cardiomyopathy and recurrent, symptomatic SMVT, or ICD shocks for SMVT in whom AADs are ineffective, contraindicated, or not tolerated, catheter ablation in specialized centers should be considered. (Class 2a) • In patients with hemodynamically well-tolerated SMVT occurring in the chronic phase of myocarditis, preserved LV function and a limited scar amenable to ablation, catheter ablation may be considered as an alternative to ICD therapy, after discussion with the patient and provided that established endpoints have been reached. (Class 2b) • Catheter ablation, in specialized centers, may be considered in cardiac sarcoidosis ICD recipients with recurrent, symptomatic SMVT, or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated. (Class 2b)

	• In patients with repaired TOF with a preserved biventricular function and symptomatic SMVT, catheter ablation or concomitant surgical ablation performed in specialized centers may be considered as an alternative to ICD therapy. (Class 2b) • **Idiopathic VF** • Isoproterenol infusion, verapamil, or quinidine for acute treatment of an electrical storm or recurrent ICD discharges should be considered in idiopathic VF. (Class 2a) • Quinidine should be considered for chronic therapy to suppress an electrical storm or recurrent ICD discharges in idiopathic VF. (Class 2a) • **Long QT syndrome** • Beta-blockers, ideally non-selective beta-blockers (nadolol or propranolol), are recommended in LQTS patients with documented QT interval prolongation, to reduce risk of arrhythmic events. (Class 1) • Mexiletine is indicated in LQT3 patients with a prolonged QT interval. (Class 1) • ICD implantation may be considered in asymptomatic LQTS patients with high-risk profile (according to the 1-2-3 LQTS Risk calculator) in addition to genotype-specific medical therapies (mexiletine in LQT3 patients). (Class 2b) • Routine diagnostic testing with epinephrine challenge is not recommended in LQTS. (Class 3) • **Early repolarization syndrome** • It is recommended that the ERS is diagnosed in a patient resuscitated from unexplained VF/PVT in the presence of ERP. (Class 1) • Quinidine in addition to an ICD should be considered for recurrent VF in ERS patients. • PVC ablation should be considered in ERS patients with recurrent VF episodes triggered by a similar PVC non-responsive to medical treatment. (Class 2a) • **CPVT** • Beta-blockers, ideally non-selective (nadolol or propranolol) are recommended in all patients with a clinical diagnosis of CPVT. (Class 1)

	• Epinephrine or isoproterenol challenge may be considered for the diagnosis of CPVT when an exercise test is not possible. (Class 2b) • **Selected populations** • Continuation of beta-blockers should be considered during pregnancy in women with ARVC. (Class 2a) • Oral metoprolol, propranolol, or verapamil should be considered for long-term management of idiopathic sustained VT during pregnancy. (Class 2a) • Catheter ablation using non-fluoroscopic mapping systems should be considered, preferably after the first trimester, in women with highly symptomatic recurrent SMVT refractory or who are intolerant to AADs. (Class 2a)
2020 Canadian Cardiovascular Society/Canadian Heart Rhythm Society Position Statement on the Management of Ventricular Tachycardia and Fibrillation in Patients With Structural Heart Disease[7]	• All patients presenting with VT/ VF should undergo a comprehensive initial evaluation including a detailed history, physical examination, laboratory investigations, ECG, ICD interrogation (if present) and transthoracic echocardiography (Strong Recommendation, Low-Quality Evidence). • CMR imaging is recommended to be performed in patients who present with VT/VF when the initial evaluation has failed to establish the etiology of the underlying heart disease (Strong Recommendation, Moderate-Quality Evidence). • The administration of I.V. amiodarone or lidocaine for acute treatment of patients with shock-refractory VT/VF (failure of at least 1 attempt at defibrillation) or patients with recurrent polymorphic VT/ VF, unless there is a strong suspicion of torsade de pointes is recommended. (Strong Recommendation, Moderate-Quality Evidence). • The use of b-blockade, preferably nonselective b-blockade, and I.V. amiodarone in patients with electrical storm in the setting of underlying SHD is recommended. (Strong Recommendation, Moderate-Quality Evidence). • Electrical cardioversion or I.V. procainamide for the acute treatment of stable monomorphic VT in patients with SHD is recommended. (Strong Recommendation, Moderate-Quality Evidence). • In patients with SHD and new or recurrent VT/VF, the guideline recommends: ○ (1) optimizing b-blocker dose in all patients

	○ (2) optimizing ICD programming ○ (3) consideration of initiation of additional suppressive therapy (either class III AAD therapy or catheter ablation), particularly in patients with VT/VF resulting in ICD shock(s), in those with a high burden of VT/VF, and in those with severe symptoms/hemodynamic compromise or psychosocial distress (Strong Recommendation, Low-Quality Evidence). • The guideline recommends optimizing b-blocker dose and using additional suppressive therapy (amiodarone or catheter ablation), in patients with SHD who present with electrical storm (Strong Recommendation, Moderate Quality Evidence). • B-blocker therapy, titrated to a maximally tolerated dose (optimized dose), in patients with SHD with VT/VF is recommended (Strong Recommendation, Moderate-Quality Evidence). • If AAD therapy is chosen for suppressive therapy, the guideline recommends that either sotalol or amiodarone be used as first-line AAD therapy for suppression of VT/VF in patients with SHD (Strong Recommendation, High quality of evidence). • Catheter ablation can be considered, in selected patients, as first-line suppressive therapy, in addition to b-blocker therapy, for patients with ischemic cardiomyopathy (previous MI) and monomorphic VT (Conditional Recommendation, Low-Quality Evidence). • Catheter ablation of monomorphic VT in patients with ischemic cardiomyopathy (previous MI) in whom treatment with sotalol or amiodarone has been ineffective is recommended. (Strong Recommendation, High-Quality Evidence). • Catheter ablation of monomorphic VT in patients with nonischemic cardiomyopathy in whom treatment with sotalol or amiodarone has been ineffective is recommended. (Strong Recommendation, Low-Quality Evidence). • Mexiletine (given in addition to amiodarone) or dofetilide can be used in patients with SHD and refractory VT/VF who are not candidates or in whom therapy with

	sotalol, amiodarone, or catheter ablation has failed (Conditional Recommendation, Low-Quality Evidence) • Bipolar radiofrequency ablation, extendable/retractable radiofrequency needle ablation, stereotactic ablative radiotherapy, and sympathectomy may be considered for treatment of VT/VF after failure of one or more standard ablation procedures and after failure of amiodarone therapy (Conditional Recommendation, Low-Quality Evidence). • In patients with VT/VF, the guideline recommends ongoing incorporation of patient values and preferences in goals of care discussions, including ICD tachycardia therapy deactivation or ICD replacement with a pacemaker, particularly at times of ICD generator replacement or changes in clinical status (Strong Recommendation, Low-Quality Evidence).
2021 PACES Expert Consensus Statement on the Indications and Management of Cardiovascular Implantable Electronic Devices in Pediatric Patients[8]	• ICD implantation is indicated in patients with a diagnosis of CPVT who experience cardiac arrest or arrhythmic syncope despite maximally tolerated beta-blocker plus flecainide and/or cardiac sympathetic denervation. (Class 1- LOE C-LD) • ICD implantation is reasonable in combination with pharmacologic therapy with or without cardiac sympathetic denervation when aborted SCA is the initial presentation of CPVT. Pharmacologic therapy and/or cardiac sympathetic denervation without ICD may be considered as an alternative. (Class 2a- LOE C-LD) • ICD implantation may be considered in CPVT patients with polymorphic/bidirectional VT despite optimal pharmacologic therapy with or without cardiac sympathetic denervation. (Class 2b-LOE C-LD) • ICD implantation is not indicated in asymptomatic patients with a diagnosis of CPVT. (Class 3- LOE C-EO)
2023 HRS expert consensus statement on the management of arrhythmias during pregnancy[9]	• In pregnant patients with CPVT, pharmacological therapy as in the nonpregnant patient should be continued throughout pregnancy and the postpartum period, including during delivery and breastfeeding. (COR 1, LOE C-LD) • In pregnant patients with CPVT, with symptoms ongoing despite beta-blocker therapy, such as recurrent syncope, VT, or cardiac arrest, intensification of therapy

	with either the addition of flecainide and/or a left cardiac sympathetic denervation, and/or an ICD is recommended as in the nonpregnant patient. (Class 1, LOE C-LD) • In pregnant patients with CPVT who are genotype-positive and phenotype-negative, use of beta-blockers during pregnancy and postpartum is reasonable. (Class 2a, LOE C-LD)
2019 HRS/EHRA/APHRS/LAHRS expert consensus statement on catheter ablation of ventricular arrhythmias[10]	• In patients with bundle branch reentrant VT, catheter ablation is useful for reducing the risk of recurrent VT. (COR 1, LOE B-NR) • In patients with idiopathic left fascicular reentrant VT for whom medications are ineffective, not tolerated, or not the patient's preference, catheter ablation is useful. (COR 1, LOE B-NR) • In larger pediatric patients (>= 15 kg) with idiopathic left fascicular reentrant VT in whom medical treatment is ineffective or not tolerated, catheter ablation is useful. (COR 1, LOE B-NR) • In patients with focal fascicular VT with or without SHD, catheter ablation is useful. (COR 1, LOE B-NR) • In patients with postinfarction reentrant Purkinje fiber-mediated VT, catheter ablation is useful. (COR 1, LOE B-NR)

Appendix C. MeSH Terms PubMed

Query	Filters	Search Details	Results
((((((((((((((((Tachycardia, Ventricular[MeSH Terms]) OR (Ventricular Tachycardias[Title/Abstract])) OR (Ventricular Tachyarrhythmias[Title/Abstract])) OR (Tachyarrhythmia, Ventricular[Title/Abstract])) OR (Ventricular Tachyarrhythmia[Title/Abstract])) OR (Ventricular Tachycardia[Title/Abstract])) OR (Nonsustained Ventricular Tachycardia[Title/Abstract])) OR (Nonsustained Ventricular Tachycardias[Title/Abstract])) OR (Tachycardia, Nonsustained Ventricular[Title/Abstract])) OR (Ventricular Tachycardia, Nonsustained[Title/Abstract])) OR (Paroxysmal Supraventricular Tachycardia[Title/Abstract])) OR (Paroxysmal Supraventricular Tachycardias[Title/Abstract])) OR (Supraventricular Tachycardia, Paroxysmal[Title/Abstract])) OR (Tachycardia, Paroxysmal Supraventricular[Title/Abstract])) OR (Idiopathic Ventricular Tachycardia[Title/Abstract])) OR (Idiopathic Ventricular Tachycardias[Title/Abstract])) OR (Tachycardia, Idiopathic Ventricular[Title/Abstract])) OR (Ventricular Tachycardia, Idiopathic[Title/Abstract])	Guideline, in the last 5 years	("tachycardia, ventricular"[MeSH Terms] OR "ventricular tachycardias"[Title/Abstract] OR "ventricular tachyarrhythmias"[Title/Abstract] OR "tachyarrhythmia ventricular"[Title/Abstract] OR "ventricular tachyarrhythmia"[Title/Abstract] OR "ventricular tachycardia"[Title/Abstract] OR "nonsustained ventricular tachycardia"[Title/Abstract] OR "nonsustained ventricular tachycardias"[Title/Abstract] OR "tachycardia nonsustained ventricular"[Title/Abstract] OR "ventricular tachycardia nonsustained"[Title/Abstract] OR "paroxysmal supraventricular tachycardia"[Title/Abstract] OR "paroxysmal supraventricular tachycardias"[Title/Abstract] OR "supraventricular tachycardia paroxysmal"[Title/Abstract] OR "tachycardia paroxysmal supraventricular"[Title/Abstract] OR "idiopathic ventricular tachycardia"[Title/Abstract] OR "idiopathic ventricular tachycardias"[Title/Abstract] OR "tachycardia idiopathic ventricular"[Title/Abstract] OR "ventricular tachycardia idiopathic"[Title/Abstract]) AND ((y_5[Filter]) AND (guideline[Filter]))	17

Appendix D. Treatment Algorithm

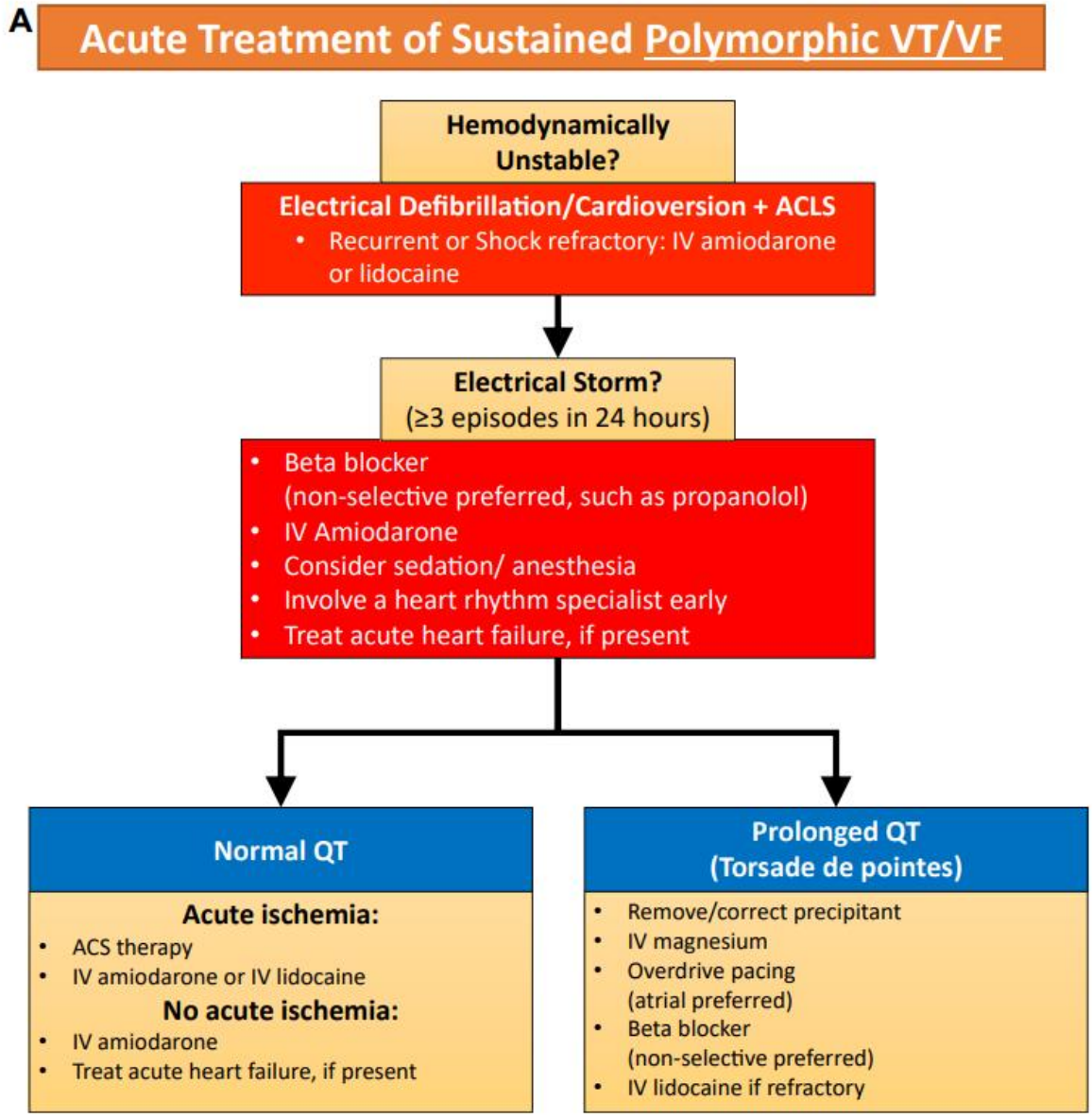

Figure 3. *Acute management of sustained polymorphic VT treatment algorithm. Retrieved from the Canadian Cardiovascular Society/Canadian Heart Rhythm Society 2020 guideline.*

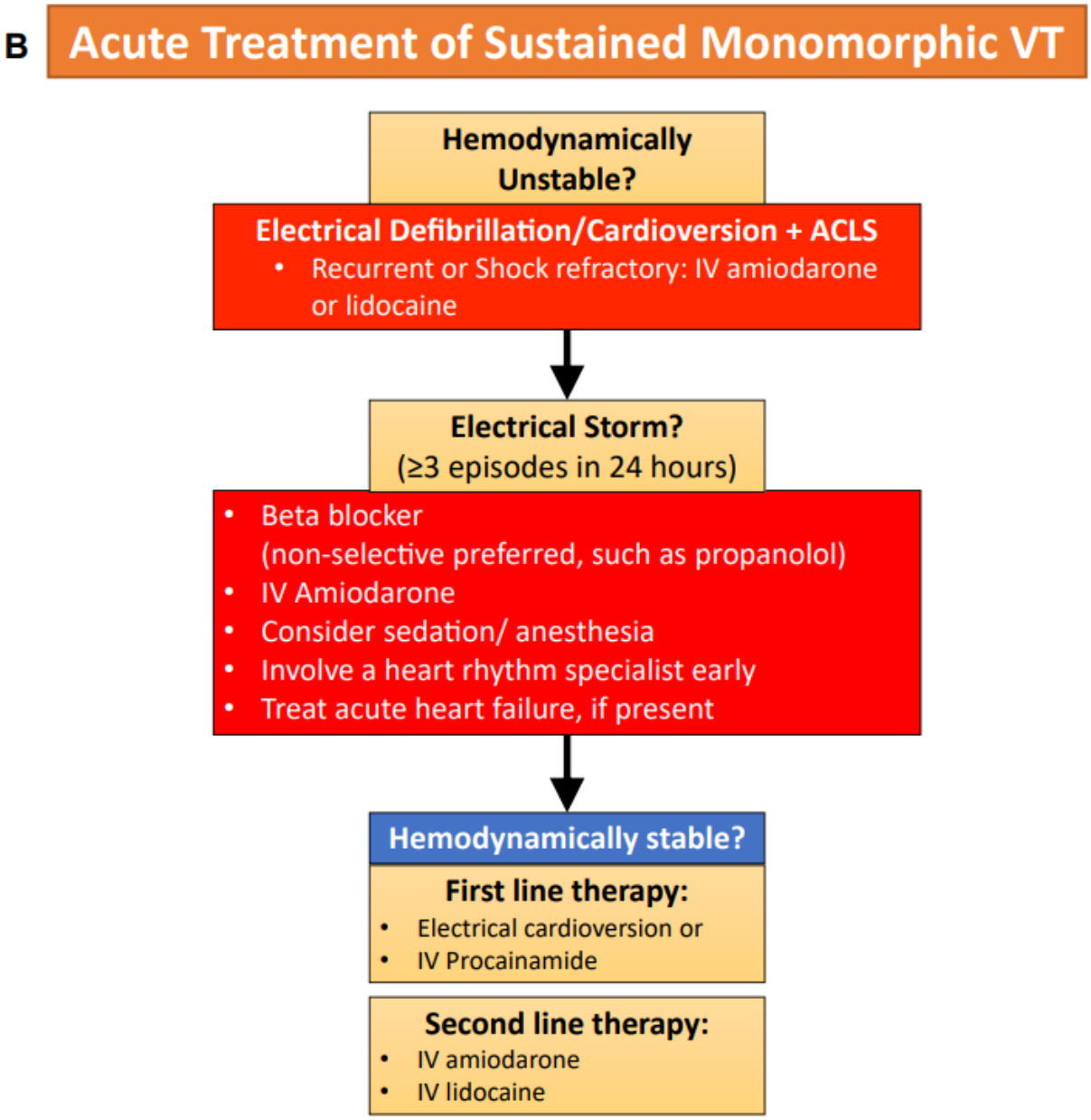

Figure 4. *Acute management of sustained monomorphic VT treatment algorithm. Retrieved from the Canadian Cardiovascular Society/Canadian Heart Rhythm Society 2020 guideline.*

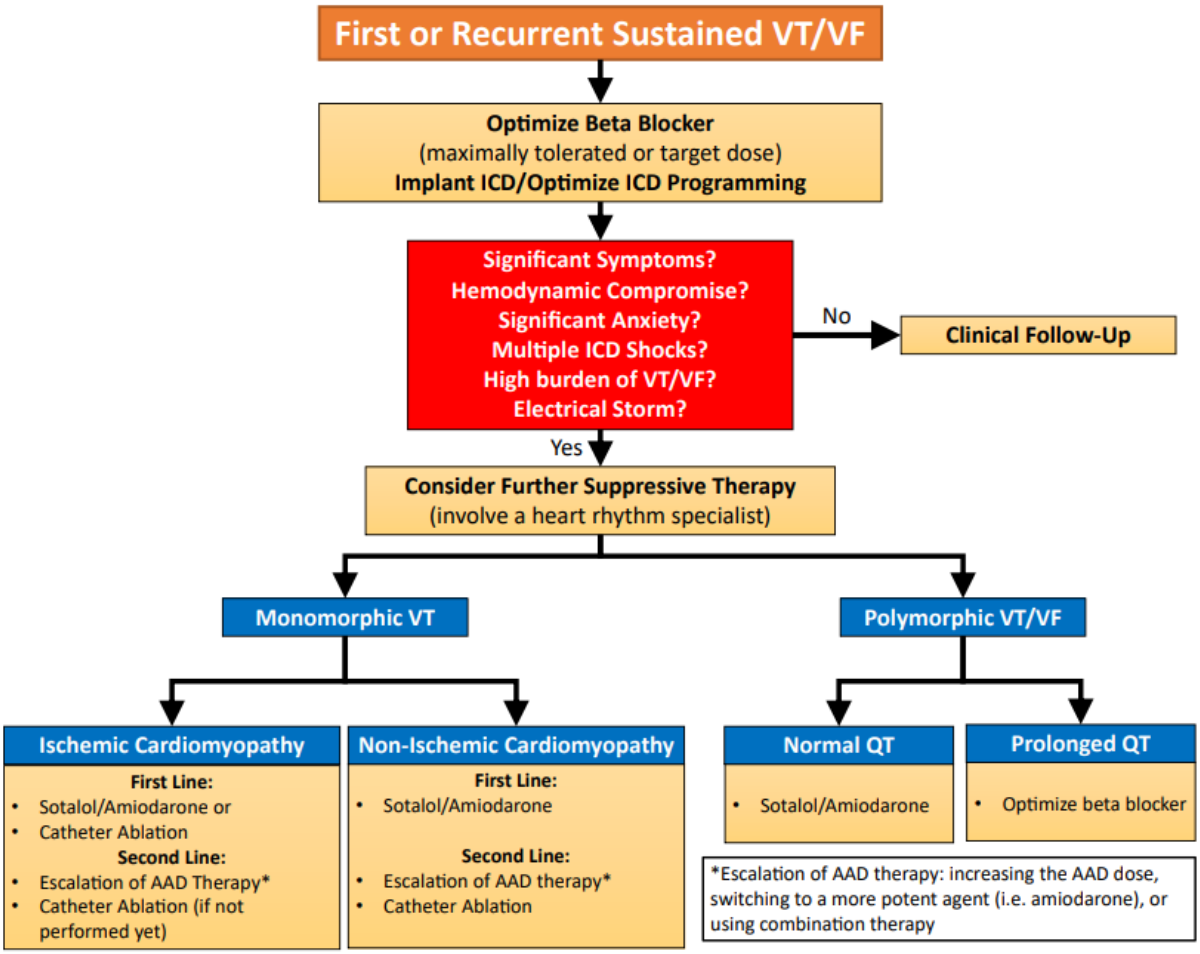

Figure 5. *First or recurrent sustained VT/VF treatment algorithm. Retrieved from the Canadian Cardiovascular Society/Canadian Heart Rhythm Society 2020 guideline.*