Antiarrhythmic agent



Drugs affecting the cardiac action potential. The sharp rise in voltage ("0") corresponds to the influx of sodium ions, whereas the two decays ("1" and "3", respectively) correspond to the sodium-channel inactivation and the repolarizing eflux of potassium ions. The characteristic plateau ("2") results from the opening of voltage-sensitive [calcium](https://en.wikipedia.org/wiki/Calcium) channels.

**Antiarrhythmic agents**, also known as **cardiac dysrhythmia medications**, are a group of [pharmaceuticals](https://en.wikipedia.org/wiki/Pharmaceutical) that are used to suppress abnormal rhythms of the [heart](https://en.wikipedia.org/wiki/Heart) ([cardiac arrhythmias](https://en.wikipedia.org/wiki/Cardiac_arrhythmias)), such as [atrial fibrillation](https://en.wikipedia.org/wiki/Atrial_fibrillation), [atrial flutter](https://en.wikipedia.org/wiki/Atrial_flutter), [ventricular tachycardia](https://en.wikipedia.org/wiki/Ventricular_tachycardia), and [ventricular fibrillation](https://en.wikipedia.org/wiki/Ventricular_fibrillation).

Many attempts have been made to classify antiarrhythmic agents. The problem arises from the fact that many of the antiarrhythmic agents have multiple modes of action, making any classification imprecise.

***Classification:-***

**1-*Clinical classification***: they classified as the drug act on:-

**A-Supraventricular arrhythmia** like;- (verapamil, cardiac aminoglycoside like digoxin, nucleotide like adenosine.

**B- Supraventricular arrhythmia and ventricular arrhythmia** like:- Amiodarone, Qunidine, Procainamide, Disopyramide, B-Blockers, Flecainide and Propafenone.

**C-Effect on ventricular arrhythmias** only like;- Lignocaine, , [Phenytoin](https://en.wikipedia.org/wiki/Phenytoin), [Mexiletine](https://en.wikipedia.org/wiki/Mexiletine) and [Tocainide](https://en.wikipedia.org/wiki/Tocainide).

***2-On their effects of the physio-elictrical activity*** [***(Vaughan Williams classification***](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Vaughan_Williams_classification)***)***

* + [1.1Class I agents](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Class_I_agents)
	+ [1.2Class II agents](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Class_II_agents)
	+ [1.3Class III agents](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Class_III_agents)
	+ [1.4Class IV agents](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Class_IV_agents)
	+ [1.5Class V / other agents](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#Class_V_/_other_agents)
	+ [1.6History](https://en.wikipedia.org/wiki/Antiarrhythmic_agent#History)

Vaughan Williams classification

The Vaughan Williams classification was introduced in 1970 by [Miles Vaughan Williams](https://en.wikipedia.org/wiki/Miles_Vaughan_Williams).

Miles was the tutor for Pharmacology at [Hertford College](https://en.wikipedia.org/wiki/Hertford_College), Oxford; one of his students, [Bramah N. Singh](https://en.wikipedia.org/wiki/Bramah_N._Singh%22%20%5Co%20%22Bramah%20N.%20Singh),contributed to the development of the classification system, and had a subsequent eminent career in the United States; the system is therefore sometimes known as the **Singh-Vaughan Williams classification**.

The five main classes in the Vaughan Williams classification of antiarrhythmic agents are:

* **Class I** agents interfere with the [sodium](https://en.wikipedia.org/wiki/Sodium) (Na+) channel.
* **Class II** agents are anti-[sympathetic nervous system](https://en.wikipedia.org/wiki/Sympathetic_nervous_system) agents. Most agents in this class are [beta blockers](https://en.wikipedia.org/wiki/Beta_blockers).
* **Class III** agents affect [potassium](https://en.wikipedia.org/wiki/Potassium) (K+) efflux.
* **Class IV** agents affect [calcium](https://en.wikipedia.org/wiki/Calcium) channels and the [AV node](https://en.wikipedia.org/wiki/AV_node).
* **Class V** agents work by other or unknown mechanisms.

With regards to management of atrial fibrillation, classes I and III are used in rhythm control as medical cardioversion agents, while classes II and IV are used as rate-control agents.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Class** | **Known as** | **Examples** | **Mechanism** | **Medical uses** |
| **Ia** | Fast-channel blockers | * [Quinidine](https://en.wikipedia.org/wiki/Quinidine)
* [A**j**maline](https://en.wikipedia.org/wiki/Ajmaline)
* [Procainamide](https://en.wikipedia.org/wiki/Procainamide)
* [Disopyramide](https://en.wikipedia.org/wiki/Disopyramide)
 | [(Na+) channel](https://en.wikipedia.org/wiki/Sodium_channel) block (intermediate association/dissociation) and K+ channel blocking effect; affects QRS complex | * [Ventricular arrhythmias](https://en.wikipedia.org/wiki/Ventricular_arrhythmia)
* Prevention of paroxysmal [recurrent atrial fibrillation](https://en.wikipedia.org/wiki/Recurrent_atrial_fibrillation) (triggered by [vagal](https://en.wikipedia.org/wiki/Vagus_nerve) overactiy)
* Procainamide in [Wolff-Parkinson-White syndrome](https://en.wikipedia.org/wiki/Wolff-Parkinson-White_syndrome)
* Increases QT interval
 |
| **Ib** |  | * [Lidocaine](https://en.wikipedia.org/wiki/Lidocaine)
* [Phenytoin](https://en.wikipedia.org/wiki/Phenytoin)
* [Mexiletine](https://en.wikipedia.org/wiki/Mexiletine)
* [Tocainide](https://en.wikipedia.org/wiki/Tocainide)
 | Na+ channel block (fast association/dissociation); can prolong QRS complex in overdose | * Treatment and prevention during and immediately after [myocardial infarction](https://en.wikipedia.org/wiki/Myocardial_infarction), though this practice is now discouraged given the increased risk of [asystole](https://en.wikipedia.org/wiki/Asystole)
* [Ventricular tachycardia](https://en.wikipedia.org/wiki/Ventricular_tachycardia)
 |
| **Ic** |  | * [Encainide](https://en.wikipedia.org/wiki/Encainide)
* [Flecainide](https://en.wikipedia.org/wiki/Flecainide)
* [Propafenone](https://en.wikipedia.org/wiki/Propafenone)
* [Moricizine](https://en.wikipedia.org/wiki/Moricizine)
 | Na+ channel block (slow association/dissociation) | * Prevents [paroxysmal atrial fibrillation](https://en.wikipedia.org/wiki/Paroxysmal_atrial_fibrillation)
* Treats [recurrent tachyarrhythmias](https://en.wikipedia.org/w/index.php?title=Recurrent_tachyarrhythmias&action=edit&redlink=1) of abnormal [conduction system](https://en.wikipedia.org/wiki/Electrical_conduction_system_of_the_heart)
* Contraindicated immediately after myocardial infarction
 |
| **II** | Beta-blockers | * [Carvedilol](https://en.wikipedia.org/wiki/Carvedilol)
* [Propranolol](https://en.wikipedia.org/wiki/Propranolol)
* [Esmolol](https://en.wikipedia.org/wiki/Esmolol)
* [Timolol](https://en.wikipedia.org/wiki/Timolol)
* [Metoprolol](https://en.wikipedia.org/wiki/Metoprolol)
* [Atenolol](https://en.wikipedia.org/wiki/Atenolol)
* [Bisoprolol](https://en.wikipedia.org/wiki/Bisoprolol)
* [Nebivolol](https://en.wikipedia.org/wiki/Nebivolol)
 | [Beta blocking](https://en.wikipedia.org/wiki/Beta_blocker)Propranolol also shows some class I action | * Decrease [myocardial infarction](https://en.wikipedia.org/wiki/Myocardial_infarction) mortality
* Prevent recurrence of [tachyarrhythmias](https://en.wikipedia.org/wiki/Tachyarrhythmia%22%20%5Co%20%22Tachyarrhythmia)
* [Propranolol](https://en.wikipedia.org/wiki/Propranolol) has sodium channel-blocking effects
 |
| **III** |  | * [Amiodarone](https://en.wikipedia.org/wiki/Amiodarone)
* [Sotalol](https://en.wikipedia.org/wiki/Sotalol)
* [Ibutilide](https://en.wikipedia.org/wiki/Ibutilide)
* [Dofetilide](https://en.wikipedia.org/wiki/Dofetilide)
* [Dronedarone](https://en.wikipedia.org/wiki/Dronedarone)
* [E-4031](https://en.wikipedia.org/wiki/E-4031)
* [Vernakalant](https://en.wikipedia.org/wiki/Vernakalant)
 | [K+ channel blocker](https://en.wikipedia.org/wiki/Potassium_channel_blocker)[Sotalol](https://en.wikipedia.org/wiki/Sotalol) is also a [beta blocker](https://en.wikipedia.org/wiki/Beta_blocker) , [Amiodarone](https://en.wikipedia.org/wiki/Amiodarone%22%20%5Co%20%22Amiodarone) has Class III mostly, but also I, II, & IV activity | * In [Wolff-Parkinson-White syndrome](https://en.wikipedia.org/wiki/Wolff-Parkinson-White_syndrome)
* (Sotalol:) [ventricular tachycardias](https://en.wikipedia.org/wiki/Ventricular_tachycardias) and [atrial fibrillation](https://en.wikipedia.org/wiki/Atrial_fibrillation)
* (Ibutilide:) [atrial flutter](https://en.wikipedia.org/wiki/Atrial_flutter) and [atrial fibrillation](https://en.wikipedia.org/wiki/Atrial_fibrillation)
* (Amiodarone): haemodynamically stable ventricular tachycardia
 |
| **IV** | Slow-channel blockers | * [Verapamil](https://en.wikipedia.org/wiki/Verapamil)
* [Diltiazem](https://en.wikipedia.org/wiki/Diltiazem)
 | [Ca2+ channel blocker](https://en.wikipedia.org/wiki/Calcium_channel_blocker) | * Prevent recurrence of [paroxysmal supraventricular tachycardia](https://en.wikipedia.org/wiki/Paroxysmal_supraventricular_tachycardia)
* Reduce [ventricular rate](https://en.wikipedia.org/wiki/Ventricular_rate) in patients with [atrial fibrillation](https://en.wikipedia.org/wiki/Atrial_fibrillation)
 |
| **V** |  | * [Adenosine](https://en.wikipedia.org/wiki/Adenosine)
* [Digoxin](https://en.wikipedia.org/wiki/Digoxin)
* [Magnesium Sulfate](https://en.wikipedia.org/wiki/Magnesium_Sulfate)
 | Work by other or unknown mechanisms (direct nodal inhibition) | Used in supraventricular arrhythmias, especially in heart failure with atrial fibrillation, contraindicated in ventricular arrhythmias. or in the case of magnesium sulfate, used in ***[torsades de pointes](https://en.wikipedia.org/wiki/Torsades_de_Pointes%22%20%5Co%20%22Torsades%20de%20Pointes)*.** |

**Class I agents**

The class I antiarrhythmic agents [interfere with the sodium channel](https://en.wikipedia.org/wiki/Sodium_channel_blocker). Class I agents are grouped by what effect they have on the Na+ channel, and what effect they have on cardiac [action potentials](https://en.wikipedia.org/wiki/Action_potential).

Class I agents are called membrane-stabilizing agents. The 'stabilizing' word is used to describe the decrease of excitogenicity of the plasma membrane which is brought about by these agents. (Also noteworthy is that a few class II agents like propranolol also have a [membrane stabilizing effect](https://en.wikipedia.org/wiki/Membrane_stabilizing_effect).)

Class I agents are divided into three groups (Ia, Ib, and Ic) based upon their effect on the length of the action potential.

* Ia lengthens the action potential (right shift)
* Ib shortens the action potential (left shift)
* Ic does not significantly affect the action potential (no shift)
* 

Class Ia

* 

Class Ib

* 

Class Ic

**Class II agents**

Class II agents are conventional [beta blockers](https://en.wikipedia.org/wiki/Beta_blockers). They act by blocking the effects of [catecholamines](https://en.wikipedia.org/wiki/Catecholamine%22%20%5Co%20%22Catecholamine) at the [β1-adrenergic receptors](https://en.wikipedia.org/wiki/Adrenergic_receptor#Type_.CE.B21), thereby decreasing sympathetic activity on the heart. These agents are particularly useful in the treatment of [supraventricular tachycardias](https://en.wikipedia.org/wiki/Supraventricular_tachycardia). They decrease conduction through the [AV node](https://en.wikipedia.org/wiki/AV_node).

Class II agents include [atenolol](https://en.wikipedia.org/wiki/Atenolol), [esmolol](https://en.wikipedia.org/wiki/Esmolol%22%20%5Co%20%22Esmolol), [propranolol](https://en.wikipedia.org/wiki/Propranolol), and [metoprolol](https://en.wikipedia.org/wiki/Metoprolol%22%20%5Co%20%22Metoprolol).

**Class III agents**



**Class III**

Class III agents predominantly [block the potassium channels](https://en.wikipedia.org/wiki/Potassium_channel_blocker), thereby prolonging repolarization. Since these agents do not affect the sodium channel, conduction velocity is not decreased. The prolongation of the action potential duration and refractory period, combined with the maintenance of normal conduction velocity, prevent re-entrant arrhythmias. (The re-entrant rhythm is less likely to interact with tissue that has become refractory). The class III agents exhibit reverse-use dependence (their potency increases with slower heart rates, and therefore improves maintenance of sinus rhythm). Inhibiting potassium channels, slowing repolarization, results in slowed atrial-ventricular myocyte repolarization. Class III agents have the potential to prolong the QT interval of the ECG, and may be proarrhythmic (more associated with development of polymorphic VT).

**Class III agents**;- include: [bretylium](https://en.wikipedia.org/wiki/Bretylium), [amiodarone](https://en.wikipedia.org/wiki/Amiodarone), [ibutilide](https://en.wikipedia.org/wiki/Ibutilide), [sotalol](https://en.wikipedia.org/wiki/Sotalol%22%20%5Co%20%22Sotalol), [dofetilide](https://en.wikipedia.org/wiki/Dofetilide%22%20%5Co%20%22Dofetilide), [vernakalant](https://en.wikipedia.org/wiki/Vernakalant%22%20%5Co%20%22Vernakalant) and

 **Dronedarone**

**Class IV agents**

Class IV agents are slow [non-dihydropyridine](https://en.wikipedia.org/wiki/Calcium_channel_blocker#Non-dihydropyridine) [calcium channel blockers](https://en.wikipedia.org/wiki/Calcium_channel_blocker). They decrease conduction through the [AV node](https://en.wikipedia.org/wiki/AV_node), and shorten phase two (the plateau) of the cardiac action potential. They thus reduce the contractility of the heart, so may be inappropriate in heart failure. However, in contrast to beta blockers, they allow the body to retain adrenergic control of heart rate and contractility.

Class IV agents include [verapamil](https://en.wikipedia.org/wiki/Verapamil) and [diltiazem](https://en.wikipedia.org/wiki/Diltiazem%22%20%5Co%20%22Diltiazem).

**Class V / other agents**

Since the development of the original Vaughan Williams classification system, additional agents have been used that do not fit cleanly into categories I through IV.

Agents include:

* [Digoxin](https://en.wikipedia.org/wiki/Digoxin), which decreases conduction of electrical impulses through the AV node and increases vagal activity via its central action on the central nervous system, via indirect action, leads to an increase in [acetylcholine](https://en.wikipedia.org/wiki/Acetylcholine) production, stimulating M2 receptors on AV node leading to an overall decrease in speed of conduction.
* [Adenosine](https://en.wikipedia.org/wiki/Adenosine) is used intravenously for terminating [supraventricular tachycardias](https://en.wikipedia.org/wiki/Supraventricular_tachycardia)
* [Magnesium sulfate](https://en.wikipedia.org/wiki/Magnesium_sulfate), an antiarrhythmic drug, but only against very specific arrhythmias which has been used for ***[torsades de pointes](https://en.wikipedia.org/wiki/Torsades_de_pointes%22%20%5Co%20%22Torsades%20de%20pointes)*** (**is a specific type of abnormal heart rhythm that can lead to sudden cardiac death. It is a polymorphic ventricular tachycardia that exhibits distinct characteristics on the electrocardiogram**.).
* [Trimagnesium dicitrate](https://en.wikipedia.org/wiki/Trimagnesium_dicitrate) (anhydrous) as powder or powder caps in pure condition, better bioavailability than ordinary MgO

\*\*\***Amiodarone**

 Is an [antiarrhythmic medication](https://en.wikipedia.org/wiki/Antiarrhythmic_medication) used to treat and prevent a number of types of [irregular heartbeats](https://en.wikipedia.org/wiki/Cardiac_dysrhythmia). This includes [ventricular tachycardia](https://en.wikipedia.org/wiki/Ventricular_tachycardia) (VT), [ventricular fibrillation](https://en.wikipedia.org/wiki/Ventricular_fibrillation) (VF), and [wide complex tachycardia](https://en.wikipedia.org/wiki/Wide_complex_tachycardia), as well as [atrial fibrillation](https://en.wikipedia.org/wiki/Atrial_fibrillation) and [paroxysmal supraventricular tachycardia](https://en.wikipedia.org/wiki/Paroxysmal_supraventricular_tachycardia). It can be given by mouth, [intravenously](https://en.wikipedia.org/wiki/Intravenously), or [intraosseously](https://en.wikipedia.org/wiki/Intraosseously). When used by mouth, it can take a few weeks for effects to begin. It is the drug of choice in wolf parkinsonian syndrome (WPW Syndrome)...

\*Common side effects include feeling tired, tremor, nausea, and constipation. As amiodarone can have serious side effects, it is mainly recommended only for significant ventricular arrhythmias. Serious side effects include lung toxicity such as [interstitial pneumonitis](https://en.wikipedia.org/wiki/Interstitial_pneumonitis), [liver problems](https://en.wikipedia.org/wiki/Liver_problems), heart arrhythmias, vision problems, [thyroid problems](https://en.wikipedia.org/wiki/Thyroid_problems), and death If taken during [pregnancy](https://en.wikipedia.org/wiki/Pregnancy) or [breastfeeding](https://en.wikipedia.org/wiki/Breastfeeding) it can cause problems in the baby. It is a class III antiarrhythmic medication. It works partly by increasing the time before a heart cell can contract again

\*Amiodarone was first made in 1961 and came into medical use in 1962 for [chest pain believed to be related to the heart](https://en.wikipedia.org/wiki/Angina). It was pulled from the market in 1967 due to side effects. In 1974 it was found to be useful for arrhythmias and reintroduced It is on the [World Health Organization's List of Essential Medicines](https://en.wikipedia.org/wiki/World_Health_Organization%27s_List_of_Essential_Medicines), the most effective and safe medicines needed in a [health system](https://en.wikipedia.org/wiki/Health_system) It is available as a [generic medication](https://en.wikipedia.org/wiki/Generic_medication).

***\*\*\*Proprafenone***

It is class Ic , used for the treatment and prophylaxes of vent. Tachycardia and some supravent. Arrhythmias. It have several mechanisms of action include weak β-blocking activities, therefore its caution in COPD so it is contraindicated in bronchial asthma.

***\*\*\*\*Adenosin***

Used for treatment of choice in SVT, It has short duration of action (Half 1/2= 8-10 second , given by injection or IV infusion , its side effects is also short, its duration of action is prolong with use of Disopyramide.

It can be given with β-blockers (unlike verapamil), this drug is not preferred in asthma (C.I.), And in second degree heart block.

Its side effects: - dyspnea, bronchospasm, nausea, flashing.

**(THANK YOU)**