

# Drugs acting on the heart: anti-arrhythmics

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## Abstract

Arrhythmias are common in patients undergoing anaesthesia and surgery, as well as those in intensive care. They are associated with a variety of underlying disorders or disease states. Arrhythmias must be identified promptly and managed appropriately. In many cases, this involves prevention or correction of precipitating factors and sometimes non-pharmacological treatments (cardioversion or surgical ablation); however, anti-arrhythmic drugs are often required. These drugs may be categorized according to their mechanism of action using the Vaughan Williams classification system. However, this is less useful in determining the choice of anti-arrhythmic in clinical practice.

**Keywords** Amiodarone; anti-arrhythmia agents; arrhythmias; cardiac; digoxin; lidocaine; magnesium

## Introduction

Abnormal cardiac rhythms are caused by abnormalities of impulse generation, impulse conduction or both, and can originate anywhere in the heart. Symptoms may range from none (asymptomatic) or occasional palpitations to acute cardiovascular collapse. Although many drugs used in anaesthetic or intensive care practice affect heart rate and rhythm, the term 'anti-arrhythmic' applies to drugs affecting ionic currents within cardiac conducting pathways. Urgent drug treatment may be required for rhythms that affect cardiac output, or those that may progress to unstable tachyarrhythmias. Other arrhythmias might not require immediate therapy, but they require attention because they imply the presence of other abnormalities (Table 1). To understand arrhythmias and their treatment, it is helpful to know the normal electrophysiology of the cardiac myocyte (Figure 1).

## Classification

Anti-arrhythmic drugs can be classified according to their mode of action (Vaughan Williams classification (Table 2)). Class 1 drugs act via Na<sup>+</sup> channel blockade, Class 2 act via β blockade,

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## Learning objectives

After reading this article, you should be able to:

- draw the cardiac myocyte action potential and label anti-arrhythmic sites of action
- identify at least five common causes of arrhythmias
- name at least five commonly used anti-arrhythmic drugs and the arrhythmias they treat

Class 3 act via K<sup>+</sup> channel blockade and Class 4 are Ca<sup>2+</sup> channel blockers. Class 5 includes drugs that exert their effect by a different mechanism. This classification has limitations, however, because it does not predict which drug to use for which arrhythmia. Furthermore, some drugs have more than one action, and some arrhythmias can be treated with drugs from more than one class.

In clinical practice, the treatment of arrhythmias depends on whether cardiac function is significantly compromised, the site of the arrhythmia (supraventricular or ventricular), and the potential for progression to an unstable tachyarrhythmia. In many situations, non-pharmacological means (carotid sinus massage, withdrawal or correction of the underlying stimulus or trigger, etc.), surgical techniques (catheter ablation, implantable pacemakers/defibrillators), or electrical means (direct current (DC) cardioversion) are preferred. These techniques are outside the scope of this article.

## Which drug to use?

The first step is to accurately diagnose the arrhythmia and treat any underlying or precipitating factors (i.e. supplemental oxygen/assisted ventilation in cases of hypoxia/hypercapnia). When the rhythm has been identified, the next question is whether the arrhythmia is acute or chronic. Patients can present with a chronic arrhythmia (for example atrial fibrillation (AF)), which can require drug treatment; however, if cardiovascular function is acutely compromised, then synchronized DC cardioversion should be performed. Note that these patients are likely to be on long-term anti-arrhythmic medication and thromboprophylaxis might be required.

If the rhythm identified is of acute onset, then the treatment given will depend on clinical urgency (i.e. is the cardiac output present or is blood pressure compromised?) For emergency treatment of acute arrhythmias within the hospital setting, current Resuscitation Council (UK) algorithms are available from [www.resus.org.uk](http://www.resus.org.uk).

Most of the arrhythmias requiring urgent treatment are tachycardias; the simplest way to classify these arrhythmias is as either supraventricular tachycardias (SVTs) or ventricular tachycardias (VTs).

## Drugs to treat supraventricular tachycardias

**Adenosine:** a naturally occurring purine nucleoside that acts at specific A1 and A2 receptors. A1 receptors are coupled to potassium channels. Adenosine is used in the diagnosis and treatment of paroxysmal SVTs; it is given as a 6-mg intravenous bolus initially, followed by 12 mg and a further 12 mg if necessary. It

### Causes of arrhythmias in patients in intensive care or those undergoing anaesthesia

Anatomical	Physiological	Biochemical	Disease
Congenital	Cardiac ischaemia	Hypo/hyperkalaemia	Sepsis
Cardiac abnormality	Hypotension	Hypocalcaemia	Pneumonia
Mechanical (e.g. CVC/Hickman/PA catheter insertion)	Autonomic dysfunction	Hypomagnesaemia	Pericarditis
	Hypoxia	Drugs (e.g. epinephrine, TCADs)	Myocarditis
	Hypercapnia		
	Hyper/hypothyroid		
	Hypothermia		
	Vagal		
	Increased ICP		

In all cases, treatment of arrhythmias should be directed at the cause, when known. Correction of these factors alone may be sufficient to restore a normal rhythm, but in addition the efficacy of anti-arrhythmic drugs is usually enhanced if predisposing factors are treated first. For example, increased vagal tone can occur during stimulation/retraction on the peritoneum, extraocular muscles or uterine cervix. Uncontrolled sympathetic stimulation can cause tachydysrhythmias, e.g. during light anaesthesia. The management of vagal bradycardias is to release the traction/stimulation of these areas and administer a vagolytic, e.g. atropine (600 µg) or glycopyrrolate (200 µg).

Treatment of acute arrhythmias depends on clinical urgency (i.e. is the cardiac output or blood pressure compromised, or is this a precursor of a more serious dysrhythmia?). For emergency treatment of acute arrhythmias within the hospital setting, current Resuscitation Council (UK) algorithms<sup>1</sup> are available from [www.resus.org.uk](http://www.resus.org.uk).

CVC, central venous catheter; PA, pulmonary artery catheter; TCAD, tricyclic antidepressants; ICP, intracranial pressure.

**Table 1**

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