Understanding the drugs used during cardiac arrest response

**AUTHOR** David Gallimore, MSc, BSc, RGN, is tutor in adult nursing, School of Health Science, University of Wales Swansea.


During cardiac arrest the survival of the patient depends on a rapid response that provides high-quality treatment based on the latest guidelines. Administration of the correct drugs is an important aspect of this process and one in which nurses are taking increasingly important role. This article will help nurses to understand the use of drugs in cardiac arrest resuscitation, explaining the rationale for their use, the dosage and any significant problems likely to be encountered.

The collapse or sudden deterioration of a patient in a clinical environment can have a number of possible causes. If it is identified as being due to a cardiac arrest, the survival chances of the patient will be increased by following guidelines established by the Resuscitation Council (UK) (2005). These describe the sequence of actions that should be undertaken at the various stages of the resuscitation attempt.

This article will consider the pharmacological treatment of cardiac arrest. The full guidelines can be found at the Resuscitation Council website (www.resus.org.uk). To follow these guidelines accurately it is necessary to be able to identify the various heart rhythms associated with a cardiac arrest. An explanation of these can be found in basic textbooks such as *The ECG Made Easy* (Hampton, 2003).

**Adrenaline**

This is the first drug given in all causes of cardiac arrest and should be readily available in all clinical areas. Adrenaline concentrates the blood around the vital organs, specifically the brain and the heart, by peripheral vasoconstriction. These are the organs that must continue to receive blood to increase the chances of survival following cardiac arrest. Adrenaline also strengthens cardiac contractions as it stimulates the cardiac muscle. This further increases the amount of blood circulating to the vital organs, and also increases the chance of the heart returning to a normal rhythm.

Adrenaline can be given repeatedly during a cardiac arrest until the condition of the patient improves. The Resuscitation Council recommends that it is given as soon as possible once a cardiac arrest has been identified. This can be repeated every 3–5 minutes. The suggested administration route is by a central line, as it will then reach the cardiac tissue more rapidly (Resuscitation Council UK, 2005). If this is not available it may be administered through a cannula in a peripheral vein. If so, the cannula should be flushed with at least 20ml of 0.9% sodium chloride. This will ensure the entry of the drug into the circulation.

If venous access cannot be obtained and the patient is intubated, adrenaline can be given via the endotracheal tube directly into the lungs. Manufacturers suggest that adrenaline may be injected directly into the heart through the chest wall if no other route is available (eMC, 2006). This can be a difficult procedure and should only be attempted by a competent clinician and when all other attempts to gain access have failed.

Once an organised rhythm has been established the use of adrenaline must be reassessed as excess amounts can precipitate ventricular fibrillation. It is also important to note that adrenaline reacts with sodium bicarbonate to produce solid material. For this reason these two drugs should not be administered through the same IV route without adequate flushing with 0.9% sodium chloride.

**Amiodarone**

This drug is given during cardiac arrest to treat specific cardiac arrhythmias, mainly ventricular fibrillation and ventricular tachycardia. The Resuscitation Council...
**Box 1. Drugs recommended for use in cardiac arrest**

a) Immediately available prefilled syringes
- Adrenaline (epinephrine) 1mg (1:10,000) x 4
- Atropine 3mg x 1
- Amiodarone 300mg x 1

b) Other readily available drugs

**Intravenous medications:**
- Adenosine 6mg x 10
- Adrenaline 1mg (1:10,000) x 4
- Adrenaline 1mg (1:1,000) x 2
- Amiodarone 300mg x 1
- Calcium chloride 10ml of 100mg per ml x 1
- Chlorphenamine 10mg x 2
- Furosemide 500mg x 2
- Glucose 10% 500ml x 1
- Hydrocortisone 100mg x 2
- Lidocaine 100mg x 1
- Magnesium sulphate 50% solution 2g (4ml) x 1
- Midazolam 10mg x 1
- Naloxone 400mcg x 5
- Normal sodium chloride 10ml ampoules
- Potassium chloride for injection
- Sodium bicarbonate 8.4% – 50ml x 1

**Other medications/equipment:**
- Salbutamol and ipratropium bromide nebulises
- Nebuliser device and mask
- Glyceryl trinitrate (GTN) spray
- Aspirin

Source: Resuscitation Council (UK), 2005

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 recommends that the first treatment for ventricular fibrillation or ventricular tachycardia should be electrical defibrillation. If this is unsuccessful after three attempts amiodarone should be given.

Amiodarone has a complex effect on the heart but the main effect is to slow down the metabolism of cardiac tissue. The drug also blocks the action of hormones that speed up the heart rate. The overall effect is to slow the heart. This is important in a cardiac arrest when the heart is beating too fast to produce a normal circulation.

Manufacturer’s guidelines state (eMC, 2006) that there should be an interval between bolus doses of amiodarone of at least 15 minutes. This can be continued by an infusion over 24 hours. Amiodarone is not compatible with sodium chloride and must at all times be diluted in 5% dextrose.

It can be administered through a cannula situated in a peripheral vein but localised irritation and discomfort are a common problem and are more likely to occur if the drug is given as a continuous infusion. This is not quite so important in the emergency situation but if the patient requires a prolonged infusion then central venous access should be considered.

The side-effect of this drug most relevant to cardiac arrest is bradycardia. For this reason a patient receiving an infusion of IV amiodarone should be monitored in a critical care environment such as a coronary care or intensive care unit. This reduced heart rate can be reversed by atropine and this drug should be available when amiodarone is being administered intravenously.

**Lidocaine**

This drug is similar to amiodarone in that it is given to treat specific cardiac arrhythmias, again mainly ventricular fibrillation and ventricular tachycardia. It reduces the electrical activity of cardiac tissue and so is able to slow down a very fast heart rate.

The Resuscitation Council recommends that lidocaine only be given in situations where amiodarone is not available. It should not be given at the same time as amiodarone, and should not be given if amiodarone has already been administered.

It is recommended that IV lidocaine is given as a bolus dose over 2-4 minutes. The manufacturer recommends (eMC, 2006) at least a five-minute interval between subsequent doses and there will also be a recommended maximum dose over an hour (see local guidelines).

Bolus intravenous infusions have a short duration of action (15 to 20 minutes), so if the patient’s condition demands it a repeat bolus should be given within this time period and then a continuous infusion commenced. It is not normally recommended that the infusion be continued for longer than 24 hours. As with amiodarone, the side-effects of this drug are bradycardia together with hypotension, and continual cardiac monitoring is recommended.

**Atropine**

The action of this drug is to block the effect of the vagus nerve on the heart. This nerve normally slows heart rate and, during cardiac arrest, is a common cause of asystole. Atropine also acts on the conduction system of the heart and accelerates the transmission of electrical impulses through cardiac tissue.

In cardiac arrest it is given to reverse asystole and severe bradycardia. The Resuscitation Council recommends that atropine be given for pulseless

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**REFERENCES**


electrical activity with a rate of less than 60 beats per minute or in complete asystole.

This drug should be administered intravenously and the dose depends on the heart rhythm. For bradycardia a dose of 0.5mg should be given and repeated every five minutes until a satisfactory heart rate is achieved. In asystole a single dose of 3mg should be given and this should not be repeated unless the cardiac rhythm changes to bradycardia or pulseless electrical activity.

If IV access cannot be obtained then atropine can be given by an endotracheal tube at a dose two to three times as high as that given intravenously.

**Additional drugs**

The previously mentioned drugs are administered either as soon as the cardiac arrest has been diagnosed (adrenaline) or once the electrical activity of the heart has been assessed on a cardiac monitor (amiodarone or atropine). The following drugs are given once the above have been tried and there is no improvement in the patient’s condition. Their administration requires a knowledge of the patient’s past medical history or a history of the circumstances of the arrest.

A list of the drugs recommended by the Resuscitation Council for use during a cardiac arrest is given in Table 1 (p.25). Below is a description of the specific applications of some of the more commonly used drugs.

**Calcium chloride**

Calcium is essential for the contraction of muscular tissue throughout the body, and is especially important for the strength of contraction of cardiac tissue. If given during cardiac arrest it can stabilise the contraction of cardiac tissue after metabolic changes have caused instability and arrhythmias (Hollander-Rodriguez and Calvert, 2006).

It has been suggested that calcium can improve weak or inefficient myocardial contractions when adrenaline has failed. This is especially the case following open-heart surgery (eMC, 2006).

Calcium can also be used to protect against a number of metabolic conditions that cause pulseless electrical activity, including raised blood potassium levels, lowered blood calcium levels and overdose of magnesium or calcium channel blocking drugs.

Calcium chloride must be administered intravenously and must not be injected directly into tissue due to the high risk of tissue necrosis. It should be given through a small-bore cannula placed in a large vein, again to reduce the risk of damage to the surrounding tissue. Due to a chemical interaction calcium chloride should not be given through the same venous access point as sodium bicarbonate.

There are two main side-effects of calcium that are important in the emergency cardiac arrest situation. The first is that repeated injections can increase blood acidity and should be used with caution in patients who have lowered blood pH. As this is found in a large number of patients following a cardiac arrest frequent monitoring of arterial blood pH is advised. Second, IV administration of calcium chloride can cause hypotension due to peripheral vasodilation and, less commonly, bradycardia and cardiac arrhythmias.

**Magnesium sulphate**

Magnesium is an important electrolyte involved in the contraction of muscular tissue, including cardiac muscle. A reduction in blood levels of this element can frequently cause cardiac arrhythmias, often leading to cardiac arrest.

Common causes of excessive magnesium loss from the body include long-term use of potassium-losing diuretics, alcohol misuse or diarrhoea. It has also been suggested that magnesium can help stabilise arrhythmias caused by low potassium levels and digoxin toxicity (eMC, 2006).

The Resuscitation Council recommends that magnesium be administered intravenously if there are suggestions that a low magnesium level has contributed to the cardiac arrest.

When giving magnesium intravenously it is important that there is close monitoring of blood pressure, urine output and respiratory rate.

**Miscellaneous drugs**

The remaining drugs recommended by the Resuscitation Council should be readily available during the resuscitation process but will not be required immediately. They are used to treat specific medical conditions that may have caused the cardiac arrest, for example an acute asthmatic episode. They are also used to treat complications frequently associated with cardiac arrest such as fluid overload due to heart failure.

These drugs should be administered as directed by the clinician managing the cardiac arrest and are not specifically included in the Resuscitation Council guidelines.

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**Guided reflection**

*Use the following points to write a reflection for your PREP portfolio:*

- Identify the last time you encountered a patient in cardiac arrest;
- Detail a piece of information from this article that could have helped you with that patient;
- Outline how you could use the information in this article in your future practice;
- Explain how you intend to share what you have learnt with your colleagues.