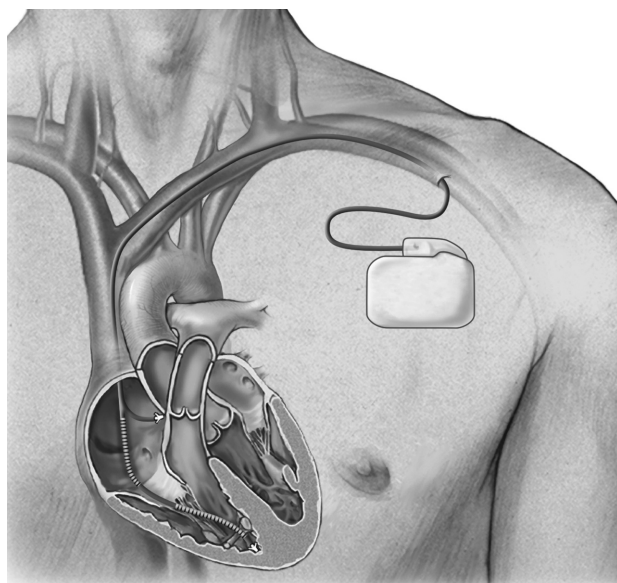


## INTRODUCTION

The Implantable Cardioverter Defibrillator (ICD) has revolutionised the management of patients at risk of developing life-threatening ventricular arrhythmia. Several clinical trials have testified to their effectiveness in reducing deaths from sudden cardiac arrest in selected patients,<sup>1-5</sup> and the devices are implanted with increasing frequency.<sup>6-8</sup>

ICDs are used in both children and adults.

ICD systems consist of a generator connected to electrodes placed transvenously into cardiac chambers (the ventricle, and sometimes the right atrium and / or the coronary sinus (**Figure 1**)). The electrodes serve a dual function allowing the monitoring of cardiac rhythm and the administration of electrical pacing, defibrillation and cardioversion therapy. Modern ICDs are slightly larger than a pacemaker and are usually implanted in the left subclavicular area (**Figure 1**). The ICD generator contains the battery and sophisticated electronic circuitry that monitors the cardiac rhythm, determines the need for electrical therapy, delivers treatment, monitors the response and determines the need for further therapy.



**Figure 1** – Usual Location of an ICD (used with the permission of medmovie.com).

The available therapies include:

- Conventional programmable pacing for the treatment of bradycardia
- Anti-tachycardia Pacing (ATP) for ventricular tachycardia (VT)
- Delivery of Biphasic shocks for the treatment of ventricular tachycardia and ventricular fibrillation (VF)

- Cardiac resynchronisation therapy (CRT) (biventricular pacing) for the treatment of heart failure.

These treatment modalities and specifications are programmable and capable of considerable sophistication to suit the requirements of individual patients. The implantation and programming of devices is carried out in specialised centres. The patient should carry a card or documentation which identifies their ICD centre and may also have been given emergency instructions.

The personnel caring for such patients in emergency situations are not usually experts in arrhythmia management, nor familiar with the details of the sophisticated treatment regimes offered by modern ICDs. Moreover, the technology is complex, and evolving rapidly. The non-specialist may have difficulty remaining familiar with the detail of this. In an emergency, patients will often present to the ambulance service or Emergency Department (ED), and the purpose of this guidance is to help those responsible for the initial management of these patients.

## GENERAL PRINCIPLES

Some important points should be made at the outset.

When confronted with a patient fitted with an ICD who has a persistent or recurring arrhythmia or where the ICD is firing, expert help should be summoned at the outset. Outside hospital this will normally be from the ambulance service who should be summoned immediately by dialling 999.

When confronted with a patient in cardiac arrest, the usual management guidelines are still appropriate (**refer to cardiac arrest and arrhythmia guidelines**).<sup>9,10</sup> If the ICD is not responding to VF or VT, or if shocks are ineffective, external defibrillation / cardioversion should be carried out. Avoid placing the defibrillator electrodes / pads / paddles close to or on top of the ICD; ensure a minimum distance of 5cm between the edge of the defibrillator paddle pad/electrode and the ICD site. Most ICDs are implanted in the left sub-clavicular position (see Figure 1) and are usually readily apparent on examination; the conventional (apical / right sub-clavicular) electrode position will then be appropriate. The anterior / posterior position may also be used, particularly if the ICD is right sided.

Whenever possible, record a 12-lead electrocardiogram (ECG) and record the patient's rhythm (with any shocks). Make sure this is printed out and stored electronically (where available), for future reference. Where an external defibrillator with an

electronic memory is used, (whether for monitoring or for therapy) ensure that the ECG report is printed and handed to appropriate staff. Again, whenever possible, ensure that the record is archived for future reference. Record the rhythm during any therapeutic measure (whether by drugs or electricity). All these records may provide vital information for the ICD centre that may greatly influence the patient's subsequent management.

The energy levels of the shocks administered by ICDs (up to 40 Joules) are much lower than those employed with external defibrillators (100 – 360J). **Personnel in contact with the patient when an ICD discharges will not be harmed, and no special precautions are necessary when handling or treating such patients.** Chest compression and ventilation can be carried out as normal and protective examination gloves worn as usual.

Placing a ring magnet over the ICD generator can temporarily disable the shock capability of an ICD. The magnet does not disable the pacing capability for treating bradycardia. The magnet may be kept in position with adhesive tape if required. Removing the magnet returns the ICD to the status present before application. The ECG rhythm should be monitored at all times when the device is disabled. An ICD should only be disabled when the rhythm for which shocks are being delivered has been recorded. If that rhythm is VT or VF, external cardioversion/defibrillation must be available. With some models it is possible to programme the ICD so that a magnet does not disable the shock capabilities of the device. This is usually done only in exceptional circumstances, and consequently, such patients are rare.

The manufacturers of the ICDs also supply the ring magnets. Many implantation centres provide each patient with a ring magnet and stress that it should be readily available in case of emergency. With the increasing prevalence of ICDs in the community it becomes increasingly important that emergency workers have this magnet available to them when attending these patients.

Decisions to apply a Do Not Attempt Resuscitation (DNAR) order will not be made in the emergency situation by the personnel to whom this guidance is directed. Where such an order does exist however, it should not be necessary to disable an ICD to enable the implementation of such an order.

Many problems with ICDs can only be dealt with permanently by using the programmer available at the ICD centre.

The guidelines should be read from the perspective of your position and role in the management of such patients. For example, the recommendation to

'arrange further assessment' will mean that ambulance clinician should transport the patient to hospital. For ED staff however, this might mean referral to the medical admitting team or local ICD centre.

Coincident conditions that may contribute to the development of arrhythmia (like acute ischaemia, worsening heart failure), should be managed as appropriate according to usual practice. Oxygen (O<sub>2</sub>) in high concentration will nearly always be appropriate.

Receiving ICD therapy may be unpleasant "like a firm kick in the chest", and psychological consequences may also arise.<sup>11,12</sup> It is important to be aware of these, and help should be available from implantation centres. An emergency telephone helpline may be available.

## MANAGEMENT

To be read in conjunction with the treatment algorithm (**Appendix 1**).

Approach and assess the patient and perform basic life support according to current BLS guidelines. Monitor the ECG.

### 1. If the patient is in cardiac arrest

- 1.1 Perform basic life support in accordance with current BLS guidelines. Standard airway management techniques and methods for gaining IV access (if required) should be used.
- 1.2 If a shockable rhythm is present (VF or pulseless VT), but the ICD is not detecting it, perform external defibrillation and other resuscitation procedures according to current resuscitation guidelines.
- 1.3 If the ICD is delivering therapy (whether by anti-tachycardia pacing or shocks) but is failing to convert the arrhythmia, then external defibrillation should be provided, as per current guidelines.
- 1.4 If a non-shockable rhythm is present, manage the patient according to current guidelines. If the rhythm is converted to a shockable one, assess the response of the ICD, as in 1.2 above, performing external defibrillation as required.
- 1.5 If a shockable rhythm is converted to one associated with effective cardiac output (whether by the ICD or by external defibrillation), manage the patient as usual and arrange further treatment and assessment.

## 2. If the patient is not in cardiac arrest

Determine whether an arrhythmia is present.

### 2.2 If no arrhythmia is present:

If therapy from the ICD has been effective, the patient is in sinus rhythm or is paced, monitor the patient, give O<sub>2</sub> and arrange further assessment to investigate possibility of new myocardial infarction (MI), heart failure, other acute illness or drug toxicity / electrolyte imbalance etc.

An ICD may deliver inappropriate shocks (i.e. in the absence of arrhythmia) if there are problems with sensing the cardiac rhythm or there are problems with the leads. Record the rhythm (with shocks if possible), disable the ICD with a magnet, monitor the patient and arrange further assessment with help from the ICD centre. Provide supportive treatment as required.

### 2.3 If an arrhythmia is present:

If an arrhythmia is present and shocks are being delivered, record the arrhythmia (and shocks if possible) on the ECG. Determine the nature of the arrhythmia. Transport rapidly to hospital in all cases.

#### TACHYCARDIA

2.3.1 If the rhythm is **supraventricular** i.e. sinus tachycardia, atrial flutter, atrial fibrillation, junctional tachycardia, etc. and the patient is haemodynamically stable, and the patient is continuing to receive shocks, disable the ICD with a magnet. Consider possible causes, treat appropriately and arrange further assessment in hospital.

2.3.2 If the rhythm is **ventricular tachycardia**:

- Pulseless VT should be treated as cardiac arrest (1.2 above).
- If the patient is haemodynamically stable, monitor the patient and convey to the emergency department.
- If the patient is haemodynamically unstable, and ICD shocks are ineffective, treat as per VT guideline.
- An ICD will not deliver anti-tachycardia pacing (ATP) or shocks if the rate of the VT is below the programmed detection rate of the device. Conventional management may be undertaken according to the patient's haemodynamic status.
- Recurring VT with appropriate shocks.

Manage any underlying cause (acute ischaemia, heart failure etc.). Sedation may be valuable. Disable ICD (apply magnet) **ONLY** if haemodynamically compromised.

### Key Points – Implantable Cardioverter Defibrillators (ICD)

- ICDs deliver therapy with bradycardia pacing, ATP and shocks for VT not responding to ATP or VF.
- ECG records, especially at the time that shocks are given, can be vital in subsequent patient management. A recording should always be made if circumstances allow.
- Cardiac arrest should be managed according to normal guidelines.
- Avoid placing the defibrillator electrode over or within 5cm of the ICD generator site.
- A discharging ICD will not harm a rescuer touching the patient or performing CPR.
- An inappropriately discharging ICD can be temporarily disabled by placing a ring magnet temporarily over the ICD site.

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## METHODOLOGY

Refer to methodology section.

# The Implantable Cardioverter Defibrillator (ICD)

## APPENDIX 1 – ICD Treatment Algorithm

