Defibrillation 2: using defibrillators in hospital

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Author Phil Jevon is resuscitation officer and clinical skills lead at Manor Hospital, Walsall.


Patients who have a cardiac arrest in hospital should, if it is indicated, be defibrillated as quickly as possible – ideally within three minutes.

Most hospital wards and other clinical areas have access to defibrillators with both advisory (semi-automated) and manual modes. The former enables first responders, including nurses without ECG interpretation skills, to defibrillate the patient while awaiting the arrival of the cardiac arrest team who can then select and use the manual mode.

Most hospital nurses will be trained in advisory defibrillation, while a few will be trained in manual defibrillation. This article provides an overview of defibrillation in hospital, and looks at both advisory and manual defibrillation.

Approximately 30% of cardiac arrests in hospital are caused by ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) (Gwinnutt et al, 2000). The definitive treatment is rapid defibrillation, with the delay from collapse to delivery of the first shock being the single most important determinant of survival (Resuscitation Council (UK), 2011). Prompt defibrillation can achieve survival rates as high as 80% (Spearpoint et al, 2000). Defibrillation can be defined as the termination of fibrillation (no VF/pulse VT) five seconds post shock (RCUK, 2011).

Delayed defibrillation is associated with lower survival rates. One large US study showed that 39.3% of patients defibrillated in under two minutes survived to discharge, compared with 22.2% who were defibrillated after two minutes (Chan et al, 2008).

Ventricular fibrillation
In VF (see page 16), the myocardium depolarises at random (uncoordinated electrical activity), causing loss of cardiac output and cardiac arrest. There are many causes, including myocardial ischaemia, electrolyte imbalance, hypothermia, drug toxicity and electric shock (Jevon, 2009).

Mechanism of defibrillation
It is thought that successful defibrillation occurs when a critical mass of myocardium is depolarised by the passage of an electric current (RCUK, 2011). This will then

5 key points
1 About 30% of in-hospital cardiac arrests are caused by ventricular fibrillation or pulseless ventricular tachycardia
2 Prompt defibrillation can achieve survival rates as high as 80%
3 Successful defibrillation occurs when a critical mass of myocardium is depolarised by the passage of an electric current
4 New guidelines for defibrillation in hospital aim to minimise the time spent on defibrillation that interrupts the delivery of chest compressions
5 With advisory defibrillation, it is important to follow the manufacturer’s recommendations

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New guidelines for defibrillation in hospital

New guidelines for defibrillation in hospital aim mainly to minimise the time defibrillation interrupts the delivery of chest compressions. They put a greater emphasis on minimising the duration of the pauses in the chest compressions in the pre- and post-defibrillation periods, and recommend that chest compressions are continued while the defibrillator is charging.

The risk of harm from a defibrillatory shock is minimal, particularly if the person performing chest compressions is wearing gloves. The pre-defibrillation pause in chest compressions should ideally be less than five seconds. The safety check just before defibrillation should be very rapid, again minimising the pre-defibrillation pause in chest compressions (RCUK, 2010).

The delivery of up to three defibrillation

BOX 1. PROCEDURE FOR ADVISORY DEFIBRILLATION

Most nurses working in hospital will be trained in advisory defibrillation. The following “general principles procedure” for it, using self-adhesive defibrillation electrodes, is based on the Resuscitation Council (UK) (2011) guidelines.

It is important to follow the manufacturer’s recommendations and voice/visual prompts given by the defibrillator.

● Confirm cardiac arrest and ensure the cardiac arrest team is alerted; request a defibrillator and cardiac arrest trolley

● Commence cardiopulmonary resuscitation (CPR) at 30 compressions to two ventilations

● As soon as the defibrillator arrives, switch it on and prepare the patient’s chest if necessary (see text, overleaf). Ensure CPR continues

● Apply self-adhesive defibrillation electrodes to the patient’s bare chest following the manufacturer’s recommendations (check the pictures on the electrodes - these will show correct placement). Ensure CPR continues

● Once the electrodes are in place and are connected to the defibrillator, ECG analysis can start; depending on the defibrillator, this will begin automatically or the user will be prompted to press an ECG analysis button. Briefly stop CPR

● If a shockable rhythm is detected, ensure the appropriate shock energy has been selected. Some advisory defibrillators will do this automatically while others require the operator to do this. Most advisory defibrillators will charge up automatically, while some - typically the older models - require the operator to press a “charge button”

● Shout “stand clear” and perform a quick visual check of the area to ensure that all people are clear

● Press the shock button(s) to discharge the shock

● Immediately recommence CPR at 30 compressions to two ventilations

Sources: Jevon (2009) and RCUK (2011)
shocks (one after another) – known as stacked defibrillation shock – may be considered if a shockable rhythm (VF/pulseless VT) occurs during cardiac catheterisation or in the early post-operative period following cardiac surgery. This is also the recommendation in a witnessed collapse when a patient is already being monitored and connected to a manual defibrillator.

The precardial thump for the emergency treatment of a shockable rhythm is rarely effective (Haman L et al, 2000), so the new guidelines put less emphasis on it (RCUK, 2011) than previously. The precardial thump should not cause delay in calling for help or getting a defibrillator. Applying a precardial thump is only recommended in a shockable rhythm, in a witnessed monitored arrest with several clinicians and when a defibrillator is not immediately at hand (Deakin et al, 2000a). The procedure for advisory defibrillation is outlined in Box 1 and manual defibrillation in Box 2.

Factors increasing the likelihood of successful defibrillation

Resistance to the flow of electric current through the chest, known as transcutaneous impedance, is influenced by the size of the self-adhesive defibrillation electrodes and the contact between the electrodes and the patient’s chest (RCUK, 2011).

The usual size of electrodes is 8-12cm.

Electrode-to-skin contact can be poor if the patient has a hairy chest. This is because air can become trapped between the electrode and the skin increasing impedance, reducing defibrillation efficacy and causing arcing (sparks), burning the patient’s chest. If a patient has a hairy chest and a razor is immediately available, quickly remove hair from the area where the electrode is going to be placed; if a razor is not immediately available, do not delay applying electrodes and defibrillation (RCUK, 2011).

Delivery of appropriate shock energy increases the likelihood of successful defibrillation, reduces the number of repetitive shocks needed and limits myocardial damage (Jevon, 2009). The shock energy selected will depend on whether the defibrillator is monophasic or biphasic.

» Monophasic: All shocks should be at 360J.

» Biphasic: Typically, the first stock is at 150-200J and the second, and all subsequent shocks, at 150-360J, as recommended by the manufacturer and local policy (RCUK, 2011).

It is important that nurses are familiar with the defibrillator they will be expected to use.

Standard position for self-adhesive defibrillation electrodes

The standard position for the self-adhesive defibrillation electrodes is:

» To the right of the sternum and just below the clavicle;

» Left mid-axillary line (approximately where the V6 ECG electrode is positioned), avoiding breast tissue (Deakin et al, 200b).

The majority of self-adhesive defibrillation electrodes feature a picture showing the correct placement. For ECG analysis by the defibrillator and for defibrillation, it does not matter if their positions are reversed (RCUK, 2010). Should the defibrillator have an ECG monitor – which is usually the case in hospital – the ECG trace will be inverted.

Safety precautions during defibrillation

» Ensure no one is touching the patient and nothing is connected to them when a shock is delivered;

» Temporarily remove oxygen masks 1m from the patient. If a self-inflating bag with oxygen attached is connected to a tracheal tube it is not necessary to disconnect it;

» Wear gloves, which may provide a degree of protection from an accidental shock.

Conclusion

The majority of hospital wards and clinical areas now have access to defibrillators with both advisory (semi-automated) and manual modes. If indicated, patients who have a cardiac arrest in hospital should be defibrillated as promptly as possible.

References


BOX 2. PROCEDURE FOR MANUAL DEFIBRILLATION

A few nurses in hospital will be trained in manual defibrillation, for example coronary care nurses with advanced ECG interpretation skills. The following “general principles procedure” for manual defibrillation using self-adhesive defibrillation electrodes is based on Resuscitation Council (UK) (2011) guidelines.

It is important to follow the manufacturer’s recommendations and voice/visual prompts given by the defibrillator.

» Confirm cardiac arrest and ensure the cardiac arrest team is alerted; request a defibrillator and cardiac arrest trolley

» Commence cardiopulmonary resuscitation (CPR) at 30 compressions to two ventilations

» As soon as the defibrillator arrives, switch it on and prepare the patient’s chest if necessary. Ensure CPR continues

» Apply self-adhesive defibrillation electrodes to the patient’s bare chest following the manufacturer’s recommendations (check the pictures on the electrodes; these show correct placement). Ensure CPR continues

» Once the electrodes are in place and connected to the defibrillator, ask the team to stop CPR and analyse the ECG trace

» If a shockable rhythm is identified, request that chest compressions are restarted, select the appropriate shock energy and charge up the defibrillator.

Ask everyone except the person performing chest compressions to stand clear and, if necessary, remove any oxygen delivery device

» Once the defibrillator is charged, ask the person performing chest compressions to stand clear, and defibrillate the patient by pressing the shock button(s)

» Immediately recommence CPR at 30 compressions to two ventilations for a further two minutes, during which time the cardiac arrest team leader will prepare the team for the next pause in CPR

Sources: Jevon (2009) and RCUK (2011)