Guideline 11.4 – Electrical Therapy for Adult Advanced Life Support

Summary

Who does this guideline apply to?

This guideline applies to adults who require advanced life support.

Who is the audience for this guideline?

This guideline is for health professionals and those who provide healthcare in environments where equipment and drugs are available.

Recommendations

The Australian and New Zealand Committee on Resuscitation (ANZCOR) make the following recommendations:

1. A defibrillation shock is delivered as soon as a defibrillator is available.
2. Paddles or pads are placed on the exposed chest in an anterior-lateral position or an anterior-posterior position.
3. In patients with an ICD or a permanent pacemaker the defibrillator pad/paddle is placed on the chest wall ideally at least 8 cm from the generator position.
4. Self-adhesive defibrillation pads are used for defibrillation.
5. Biphasic waveforms are used for defibrillation.
6. For **Monophasic waveforms:** the initial energy level for adults is set at maximum (usually 360 Joules) for all shocks.
7. For **Biphasic waveforms:** the default energy level for adults is set at 200J for all shocks. Other energy levels may be used providing there is relevant clinical data for a specific defibrillator that suggests that an alternative energy level provides adequate shock success (e.g. Usually greater than 90%).
8. If the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy to the maximum available for subsequent shocks.
9. A single shock strategy is used in patients in cardiac arrest requiring defibrillation for VF or pulseless VT.
10. The use of AEDs to facilitate early defibrillation in hospitals is reasonable, but services that

introduce AEDs must be aware of the possible adverse impact of interruptions to CPR, especially in non-shockable rhythms.

Guideline

A defibrillation shock when applied through the chest produces simultaneous depolarization of a mass of myocardial cells and may enable resumption of organised electrical activity.

1.0 | Indications

A defibrillation shock is indicated for treating Ventricular Fibrillation (VF) and pulseless Ventricular Tachycardia (pVT).

2.0 | Timing of Defibrillation

The likelihood of defibrillation success decreases with time until definitive treatment (i.e. defibrillation) is initiated.[4] Interruptions to external cardiac compression (e.g. for rhythm assessment or pulse checks) should be minimised. Good CPR might increase the likelihood of defibrillation success[5], but the results of clinical studies assessing the usefulness of a strategy providing a period of CPR before defibrillation rather than a strategy providing immediate defibrillation are not consistent.

Defibrillation was previously extensively reviewed in the 2010 CoSTR process using methodology that was different to current GRADE methodology, consequently many of the recommendations represent Good Practice Statements.[6]

Recommendation

Deliver a defibrillation shock as soon as a defibrillator is available [Good Practice Statement].

3.0 | Positioning of Electrodes

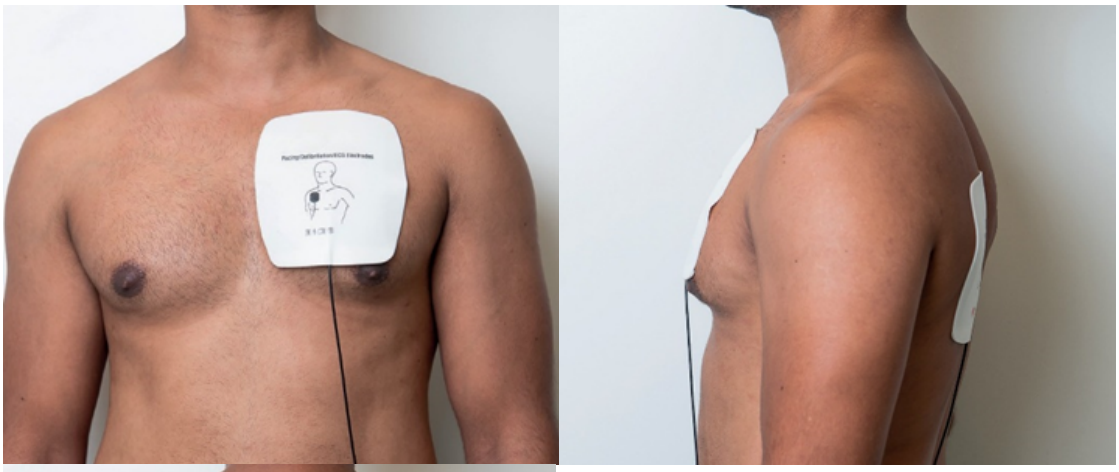
Recommendation

Place pads/paddles on the exposed chest in an anterior-lateral position. The standard position is

one electrode to the right of the upper sternum below the clavicle, and the other (apical) in the mid-axillary line and clear of breast tissue. The apical electrode must be sufficiently lateral [Good Practice Statement].
Standard anterior (pectoral)-lateral (apical) pad placement.

In large-breasted individuals it is reasonable to place the left electrode pad/paddle lateral to or underneath the left breast, avoiding breast tissue. Consideration should be given to the rapid removal of excessive chest hair prior to the application of pads/paddles but emphasis must be on minimising delays in shock delivery [Good Practice Statement].

Alternative pad positions include the anterior-posterior, bi-axillary, or postero-lateral positions.



Alternative - Anterior-posterior (AP) pad position.

Alternative - Bi-axillary position.

For the alternative postero-lateral position one electrode is placed in the left mid-axillary line, and the other electrode on the back, just inferior to the right scapula.

3.1 | Positioning of electrodes in the presence of a pacemaker/internal defibrillator

Recommendation

In patients with an ICD or a PPM, the placement of pads/paddles should not delay defibrillation. When treating an adult with a PPM or an ICD, the defibrillator pads/paddles should be placed on the chest wall ideally at least 8cm from the generator position [Good Practice Statement].

The alternative positions for pads/ paddles placement on the chest are acceptable in patients with a PPM or ICD [Good Practice Statement].

4.0 | Size of Electrodes

Recommendation

There is insufficient evidence to recommend a specific electrode size for optimal external defibrillation in adults. However, it is reasonable to use a pad size >8cm2 [Good Practice Statement].

5.0 | Self-Adhesive Pads/Paddles

Recommendation

Use self-adhesive defibrillation pads in preference to paddles for defibrillation [Good Practice Statement]. They are safe and effective and offer advantages (e.g., facilitating pacing, charging during compressions, safety [including removing risk of fires]) over defibrillation paddles [Good Practice Statement].

If paddles are used, the application of firm pressure and conductive gel pads are recommended for maximum electrical contact. Care should be taken to ensure that pads or electrodes are applied in accordance with manufacturer's instructions and are not in electrical contact with each other [Good Practice Statement].

6.0 | Defibrillation Waveform

Recommendation

ANZCOR recommends that a biphasic waveform is used in preference to a monophasic waveform [CoSTR 2015, strong recommendation, very-low-quality evidence].[7]

There is insufficient evidence to recommend any specific biphasic waveform.

In the absence of biphasic defibrillators, monophasic defibrillators are acceptable [Good Practice Statement].

7.0 | Energy Levels

Fixed versus escalating energy levels

Recommended Energy Levels

Biphasic waveforms:

ANZCOR recommends the default energy level for adults should be set at 200 J for all shocks [CoSTR 2015, strong recommendation, very low certainty evidence]. Other energy levels may be used providing there is relevant clinical data for a specific defibrillator that suggests that an alternative energy level provides adequate shock success (e.g., usually greater than 90%).

ANZCOR suggests if the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy to the maximum available for subsequent shocks [CoSTR 2015, weak recommendation, very low-quality evidence].

Monophasic waveforms:

The energy level for adults should be set at maximum (usually 360 J) for all shocks [Good Practice Statement].

8.0 | Single Shock Protocol

Priorities in resuscitation should include early assessment of the need for defibrillation, provision of CPR until a defibrillator is available, and minimisation of interruptions in chest compressions. Rescuers can optimise the likelihood of defibrillation success by optimising the performance of CPR, timing of shock delivery with respect to CPR, and the combination of waveform and energy levels. Rescuers can safely continue CPR while charging a manual defibrillator.

Recommendation

ANZCOR recommends a single-shock strategy when defibrillation is required [CoSTR 2015, strong recommendation, low-quality evidence].

When using this strategy, CPR should be resumed immediately following shock delivery and interruptions minimised [Good Practice Statement].

8.1 | Anticipatory Defibrillator Charging

With anticipatory defibrillator charging, the defibrillator is charged near the end of a compression cycle before the rhythm is checked; compressions are then paused briefly both to analyse rhythm and then either deliver a shock or dump the charge. A Scoping Review was completed during the 2020 ILCOR evidence review process suggesting anticipatory charging

may be associated with a shorter total hands-off time and reduced overall pause duration, but the evidence is not definitive.[8] Although anticipatory charging can reduce overall chest compression pause duration during the compression cycle, it can increase pre, post, and peri-shock pause duration. The clinical relevance of these findings is undetermined. Further evidence is required to evaluate the importance of different types of pause duration for patient outcomes, and the role of new defibrillator technologies and methods. Anticipatory defibrillator charging is commonly taught in Australia and New Zealand.

Recommendation

Anticipatory charging of defibrillators may be considered as part of a defibrillation strategy. Training in its use should emphasise minimising all pauses during resuscitation [Good Practice Statement].

8.2 | Defibrillation strategies for refractory VF or pVT

A systematic review of the evidence for double sequential external defibrillation (DSED) was performed during the 20209 ILCOR review process and was reviewed further in 2023[3] following the publication of a randomised control trial (RCT) assessing DSED and vector change (VC) compared to standard defibrillation.[10] DSED is the use of 2 defibrillators to deliver 2 overlapping shocks or 2 rapid sequential shocks, one with standard pad placement and the other with either anterior-posterior or additional antero-lateral pad placement. VC involves using alternate pad positions (e.g., anterior-posterior pad placement compared with standard anterior-lateral pad placement). The 2023 review did not identify new observational studies, so primarily considered the new single cluster randomized controlled trial. In this trial, survival to hospital discharge was more common among patients who received DSED or VC defibrillation than among those who received standard defibrillation.

Recommendation

ANZCOR suggests that a VC strategy may be considered for adults with cardiac arrest who remain in VF or pVT after 3 or more consecutive shocks [CoSTR 2023, weak recommendation, very low certainty of evidence].

A VC strategy is consistent with previous recommendations on alternate pad positions, does not require an additional defibrillator, and is therefore logistically easier to provide.

There is no agreed standard approach to DSED and there is concern for possible defibrillator damage with simultaneous shock delivery. The protocol in the RCT used a single person activating two defibrillations in quick succession (but not simultaneously) and did not report defibrillator damage. If a DSED strategy is used, we suggest using the method used in the trial with a single operator activating the defibrillators in quick succession, and preferably in a research setting [Good Practice Statement].

9.0 | Precautions

Be aware of electrical hazards in the presence of water, metal fixtures, oxygen and flammable substances. Warn of impending discharge by a “stand clear” command.

9.1 | Oxygen and fire risk

Recommended technique

Rescuers should take precautions to minimise sparking (by paying attention to pad/paddle placement, contact, etc.) during attempted defibrillation. Rescuers should try to ensure that defibrillation is not attempted in an oxygen-enriched atmosphere (e.g., when high-flow oxygen is directed across the chest) [Good Practice Statement].

Rescuers should minimise interruptions to CPR while defibrillating the patient. Rescuers may safely charge a manual defibrillator during CPR when using pads. The defibrillator should be disarmed if a shock is not required [Good Practice Statement]. Manual chest compressions should not continue during the delivery of a shock because safety has not been established.

Good Practice Statements for Rescuers:

- AVOID charging the pads/paddles unless they are placed on the victim’s chest.
- AVOID placing the pads/paddles over electrocardiogram (ECG) electrodes (risk of burns or sparks), ECG leads (may melt), medication patches, an implanted device (e.g., a pacemaker), or a central line insertion site.
- AVOID having, or allowing any person to have, any direct or indirect contact with the patient during defibrillation (a shock may be received).

- AVOID having the patient in contact with metal fixtures e.g., bed rails (risk of burn).
- AVOID delivering the shock with a gap between the pad/paddle and chest wall (spark hazard).
- AVOID defibrillating if the patient, operator and/or close bystander are situated in an explosive/flammable (e.g., petrol) environment.
- AVOID allowing oxygen from a resuscitator to flow onto the patient's chest during delivery of the shock when using pads/paddles (risk of fire).

10.0 | Confirmation of Shock Delivery

Check that the patient has a muscle response to the shock and there is ECG evidence of shock delivery. If it does not appear that the shock has been delivered, consider that the "synchronize" mode of the defibrillator may be on or there may be a flat battery, lead fracture, or the charge has been dumped.

11.0 | Failure of Defibrillation

If the attempt at defibrillation is unsuccessful:

- Recommence CPR with oxygen (follow algorithm in ANZCOR Guideline 11.2).
- Check pad and electrode positions.
- Check that there is adequate skin contact (clipping or shaving of body hair under the defibrillator pads/paddles may be required).
- Consider changing the defibrillator pads, pad positions, and defibrillator.

12.0 | Use of Automated External Defibrillators (AEDs)

AED use should not be restricted to trained personnel. Allowing use of AEDs by individuals without prior formal training can be beneficial and may be lifesaving. As even brief training improves performance (e.g., speed of use, correct pad placement), it is recommended that

training in the use of AEDs is provided.

Implementation of AED programs in public settings should be based on the characteristics of published reports of successful programs in similar settings.[11] Services that implement the use of AEDs must be aware of the possible adverse impact of interruptions to CPR, especially in non-shockable rhythms.[12]

Home AED use, for high-risk individuals who do not have an ICD, is safe and feasible and may be considered on an individual basis but has not been shown to change overall survival rates.[13]

Because population (e.g. rates of witnessed arrest) and program (e.g. response time) characteristics affect survival, when implementing an AED program, community and program leaders should consider factors such as location, development of a team with a responsibility for monitoring and maintaining the devices, training and retraining programs for those who are likely to use the AED, coordination with the local emergency medical services (EMS), and identification of a group of paid or volunteer individuals who are committed to using the AED for people in arrest.

12.1 | AEDs in manual mode

Modern defibrillators can be operated in both manual and semi-automatic modes.

An Evidence Update was performed as part of the ILCOR 2020 review process. The ILCOR ALS Taskforce identified additional observational studies (only 2 of which included a comparison group) and no new randomised trials, and recommendations remain unchanged.[1]

There are no survival differences between defibrillation in semi-automatic and manual modes during in- and out-of-hospital resuscitation; however, the semi-automatic mode is preferred because it is easier to use and may deliver fewer inappropriate shocks.

The defibrillation mode that results in the best outcome will be influenced by the system, and provider skills, training and ECG rhythm recognition.

Recommendation

Trained personnel may deliver defibrillation in manual mode. Use of the manual mode enables chest compressions to be continued during charging, thereby minimising the pre-shock pause. When using the defibrillator in manual mode, frequent team training and ECG rhythm

recognition skills are essential [Good Practice Statement].

The use of AEDs is reasonable to facilitate early defibrillation in hospitals, but services that introduce AEDs must be aware of the possible adverse impact of interruptions to CPR, especially in non-shockable rhythms [Good Practice Statement].

13.0 | Defibrillation of the Prone Patient

CPR and defibrillation in the prone position were included in CoSTR 2021 at a time when prone positioning was being used frequently in COVID-19 patients at risk of cardiac arrest.[2]

Recommendation

ANZCOR suggests that for patients with cardiac arrest with a shockable rhythm who are in the prone position and cannot be supinated immediately, attempting defibrillation in the prone position is a reasonable approach [Good Practice Statement].

14.0 | Use of the Defibrillator for Quality Assurance

14.1 | Data collection

Collection of data from defibrillators enables a comparison of actual performance during cardiac arrests and training events. The results of many observational studies suggest that the rate and depth of external cardiac compressions and ventilation rate were at variance with current guidelines. Monitor/defibrillators modified to enable collection of data on compression rate and depth and ventilation rate may be useful for monitoring and improving process and outcomes after cardiac arrest. However, rescuers should be aware of the potential overestimation of compression depth when the victim is on a soft surface.[14]

14.2 | Waveform analysis

VF waveform analysis to guide defibrillation management was considered in CoSTR 2010, and CoSTR 2020.

Recommendations

There is insufficient evidence to support routine use of VF waveform analysis to guide defibrillation management in adult in hospital and out of hospital cardiac arrest.[6]

ANZCOR suggests the usefulness of artifact-filtering algorithms for analysis of electrocardiographic rhythm during CPR be assessed in research [CoSTR 2020, weak recommendation, very-low-certainty evidence].

Abbreviations

Abbreviation	Meaning/Phrase
AED	automated external defibrillator
AF	atrial fibrillation
ALS	advanced life support
ANZCOR	Australian and New Zealand Committee on Resuscitation
BTE	biphasic truncated exponential
CoSTR	Consensus on Science with Treatment Recommendations
CPR	cardiopulmonary resuscitation
DSED	double sequential external defibrillation
ECG	electrocardiogram
EMS	emergency medical services
ICD	implantable cardiac defibrillator
ILCOR	International Liaison Committee on Resuscitation
J	joules
PEA	pulseless electrical activity
pVT	pulseless ventricular tachycardia
ROSC	return of spontaneous circulation

VC	vector change
VF	ventricular fibrillation

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About this Guideline

Search date/s	ILCOR literature search details and dates are available on the CoSTR page of the ILCOR website (https://costr.ilcor.org) and the relevant CoSTR documents e.g.: https://costr.ilcor.org/document/anticipatory-defibrillator-charging-task-force-scoping-review https://costr.ilcor.org/document/header-double-sequence-defibrillation-task-force-systematic-review-costr
Questions/PICOs:	Are described in the CoSTR documents (https://costr.ilcor.org)
Method:	Mixed methods including ARC NHMRC methodology before 2017 and ILCOR GRADE methodology described in ILCOR publications since 2017.
Main changes:	No major changes to the clinical aspects of the guideline. Updating of review evidence, references, and terminology to increase consistency with GRADE terminology.
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