Energy Levels for Biphasic Defibrillation

An Advisory Statement from the Australian Resuscitation Council

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Defibrillators which deliver biphasic waveforms are rapidly replacing defibrillators which deliver monophasic waveforms. Lower energy biphasic shocks cause less myocardial injury and subsequent post-resuscitation myocardial dysfunction thus potential improving the likelihood of survival.(1-4) Recommendations of the International Liaison Committee on Resuscitation (ILCOR) state that biphasic energies less than or equal to 200 joules are as efficacious as escalating higher energy monophasic shocks.(5) However, few clinical trials in adults and none in children indicate the optimal dose of biphasic shock which would achieve maximum defibrillation rate and minimum myocardial injury. Faced with the declining availability of monophasic defibrillators and paucity of data in respect to biphasic energy levels, the Australian Resuscitation Council (ARC) makes the following recommendations.

Children
Although monophasic shocks have historically been well accepted for paediatric defibrillation, the optimal dose has never been established. Instead, therapy has been guided by a single study in which the recommended doses of monophasic shocks of 2 or 4 J/kg were studied. In 71 defibrillation attempts in 27 children, 91% of shocks were successful within 10 watt-seconds (Joules) above or below an energy dose of 2 J/kg.(6) In every case, fibrillation was ultimately terminated by a shock of 4 J/kg or less. To date, no systematic study of the efficacy of biphasic shock in children has been published.

In the absence of any data it is difficult to specify the optimum dose of paediatric biphasic shock. However, a randomised trial in adults using either 150J biphasic shock or 200 to 360J monophasic shock delivered from automated external defibrillators (AEDs), revealed that the lower dose of biphasic shock defibrillated at higher rates than the higher monophasic shocks.(7) By extrapolation from this study, it is suggested that the dose of biphasic shock for children should be 1 to 2 J/kg, ie approximately half the monophasic dose, but that higher doses (up to 4J/kg) are not likely to be harmful and are more efficacious than equivalent monophasic shocks. This is supported by studies in ‘child’ and ‘infant’ animal models in which biphasic shocks were more efficacious than the same dose of monophasic shocks(8) and may be delivered in a fixed dose of 50J by an AED.(9)

The use of automated external defibrillators (AEDs) for out-of-hospital use are soon to be recommended by the International Liaison Committee on Resuscitation

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(ILCOR) for children above one year of age provided that a ‘child’ dose is delivered and that any device has been tested to ensure differentiation of ‘shockable’ from ‘non-shockable’ rhythms.(10)

Recommendation

- Biphasic energy levels of 1-2 joules per kg should be used for defibrillating ventricular fibrillation and pulseless ventricular tachycardia occurring in children.

Adults

Monophasic energy levels of 200, 200 and 360 joules have been well accepted in clinical practice and are currently recommended by the ARC and ILCOR when using monophasic defibrillators.(5,11) As biphasic defibrillators produced by different manufacturers recommend slightly different energy levels specific for their device, increasing confusion amongst practitioners has resulted as to the appropriate energy levels to be used.

To date there have been only two publications from one randomised controlled trial in humans comparing monophasic and biphasic energy levels. (7,12) In this study ventricular fibrillation occurring outside of hospital was treated using an AED. It demonstrated that 150J biphasic shocks achieved higher rates of defibrillation and return of spontaneous circulation than high energy (200J / 200J / 360J) escalating monophasic shocks. No differences were observed in the proportion of patients discharged from hospital.

Notwithstanding the limitations of this study (namely only out of hospital arrests included, non-blinded and pseudo randomisation), best clinical evidence to date would support the use of non-escalating 150J biphasic shocks in these patients. As clinical superiority of one particular biphasic waveform over another has yet to be demonstrated, it is appropriate to recommend a single energy level in order to achieve a consistent approach, particularly when using manual biphasic defibrillators. Energy levels for AEDs have been pre-set by the manufacturer, and as such do not require an energy level to be set by the user.

Recommendation

- Biphasic energy levels of 150J should be used for defibrillating ventricular fibrillation and pulseless ventricular tachycardia in adults.
References


*Member Organisations of the Australian Resuscitation Council  (www.resus.org.au)

Australasian College for Emergency Medicine
Australian and New Zealand College of Anaesthetists
Australian and New Zealand Intensive Care Society
Australian College of Ambulance Professionals
Australian College of Critical Care Nurses Ltd
Australian Defence Force
Australian Red Cross
Cardiac Society of Australia and New Zealand
Convention of Ambulance Authorities
National Heart Foundation of Australia
Royal Australian College of General Practitioners
Royal Australasian College of Surgeons
Royal College of Nursing, Australia
Royal Life Saving Society - Australia
St John Ambulance Australia
Surf Life Saving Australia
Royal Australasian College of Physicians (Paediatrics and Child Health Division)
State Branches of the ARC.

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