An escalating higher-energy regimen was better than a fixed lower-energy regimen for defibrillation in out-of-hospital cardiac arrest

Stiell IG, Walker RG, Nesbitt LP, et al. **BIPHASIC Trial: a randomized comparison of fixed lower versus escalating higher energy levels for defibrillation in out-of-hospital cardiac arrest.** Circulation. 2007;115:1511-7.

Clinical impact ratings: Emergency Med ★★★★★★☆ Hospitalists ★★★★★★☆ Cardiology ★★★★★★☆

QUESTION

In patients with out-of-hospital cardiac arrest, is an escalating higher-energy regimen better than a fixed lower-energy regimen for arrhythmia termination with an automated external defibrillator (AED) using a biphasic waveform?

METHODS

Design: Randomized controlled trial.
Allocation: Concealed.*
Blinding: Blinded (health care providers, patients, data collectors, and outcome assessors).*
Follow-up period: To death or hospital discharge.
Setting: Out-of-hospital locations in 3 Canadian cities.
Patients: 221 patients ≥ 8 years of age (mean age 66 y, 80% men) who had out-of-hospital cardiac arrest and required defibrillation (for ventricular fibrillation [VF] or pulseless ventricular tachycardia) and whose initial defibrillation was provided by first responders using an AED. Exclusion criteria included terminal illness, acute trauma, exsanguination, and not having basic cardiopulmonary resuscitation for > 10 minutes. An additional 35 patients were treated with the AED but were excluded because they did not meet the inclusion criteria or were missing data from the AED. Informed consent was not required.
Intervention: The AED devices, biphasic defibrillators used by first-responding firefighters or basic life support paramedics, were randomly programmed to deliver an escalating higher-energy regimen of 200 J, 300 J, and 360 J with repeated shocks (n = 107) or a fixed lower-energy regimen of 150 J for all shocks (n = 114). The devices were reset after each patient.
Outcomes: Successful conversion (termination of VF and establishment of organized rhythm within 60 sec), termination of VF for ≥ 5 seconds after the shock, return of spontaneous circulation, survival to 24 hours and to hospital discharge, and measures of myocardial damage.
Patient follow-up: 100% (intention-to-treat analysis).

MAIN RESULTS

The proportion of patients requiring > 1 shock was 51% in the escalating-energy group and 45% in the fixed-energy group {P = 0.32}†. The mean number of shocks delivered was {1.9 and 2.6}†, respectively. Groups did not differ for successful conversion or VF termination with the first shock, but in patients who required > 1 shock, the rate/shock for these outcomes was higher in the escalating-energy group (Table). Groups did not differ for return of spontaneous circulation (49% vs 51%), survival to 24 hours (36% vs 33%), survival to hospital discharge (16% vs 17%), or adverse myocardial outcomes.

CONCLUSION

In patients with out-of-hospital cardiac arrest who required multiple shocks, biphasic waveform defibrillation using an escalating higher-energy regimen achieved ventricular fibrillation conversion more than a fixed lower-energy regimen.

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*See Glossary.
†Calculated from data in article.

Escalating higher-energy regimen vs fixed lower-energy regimen for biphasic waveform defibrillation in out-of-hospital cardiac arrest‡

Outcomes	Subgroup	Escalating higher energy§	Fixed lower energy§	Absolute difference (95% CI)
Conversion within 60 sec	First shock (all patients)	37%	38%	−1.7% (−15 to 11)
	Multishock patients (all shocks)	37%	25%	12% (1.2 to 24)
VF termination for ≥ 5 sec	First shock (all patients)	89%	87%	1.9% (−7.0 to 11)
	Multishock patients (all shocks)	83%	71%	11% (1.6 to 21)

‡VF = ventricular fibrillation; CI defined in Glossary. Absolute difference and CI for first shock calculated from data in article.
§Rates are per shock.

COMMENTARY

Ventricular fibrillation and pulseless ventricular tachycardia comprise the common electrical pathway for sudden cardiac death. As such, their termination and the restoration of spontaneous circulation are the immediate primary targets for cardiac defibrillation, arguably the most important and life-saving intervention in the resuscitative armamentarium. Although these arrhythmias are readily treatable when they occur in the electrophysiology laboratory or when detected by an implanted cardiac defibrillator, they are, unfortunately, most often fatal in the out-of-hospital context where delays are inevitable.

Biphasic defibrillation is an important advance in both basic and advanced cardiac life support because it delivers more efficient arrhythmia-terminating electrical impulses at lower energy levels than would be required with monophasic devices (1). Although all new defibrillators are built as biphasic devices, no evidence exists to support the claim that this innovation delivers higher rates of restoration of spontaneous circulation or survival to hospital discharge (2).

Stiell and colleagues have provided important direction for future research by refining our understanding of the optimal use of these devices. However, the results of this trial are preliminary, and as is the case in the literature comparing defibrillator types, this study was limited in its ability to detect clinically meaningful differences in outcomes.

As a result of the lack of evidence available at the time, the most recent American Heart Association guidelines placed escalating energy biphasic defibrillation on equal par with fixed-energy approaches (1). Until larger trials that can address relevant clinical outcomes are conducted, the balance of decision-making is now tipped toward escalating energy levels for patients requiring a second shock from a biphasic defibrillator.

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References

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