Biphasic waveform shocks were effective and efficient for cardioversion of atrial fibrillation

Page RL, Kerber RE, Russell JK, et al., for the BiCard Investigators. **Biphasic versus monophasic shock waveform for conversion of atrial fibrillation: the results of an international randomized, double-blind multicenter trial.** J Am Coll Cardiol. 2002;39:1956-63.

QUESTION

In patients with atrial fibrillation (AF), are biphasic waveform shocks more effective than monophasic waveform shocks for successful conversion to another rhythm?

DESIGN

Randomized (unclear allocation concealment*), blinded (clinicians and patients),* controlled trial.

SETTING

11 sites (6 in the United States, 3 in the United Kingdom, and 1 each in Canada and France).

PATIENTS

203 patients who were > 18 years of age (mean age 65 y, 70% men), hemodynamically stable, and were scheduled for elective cardioversion of AF. Exclusion criteria included epicardial defibrillator electrodes and pacemaker dependence. Follow-up was 100%.

INTERVENTION

Patients were allocated to impedance-compensated truncated exponential biphasic shocks (n = 96) or damped sine wave monophasic shocks (n = 107). Patients received up to 5 shocks: 100 joules (J), 150 J, 200 J, a fourth shock at maximum output for the initial waveform (200 J biphasic, 360 J monophasic), and a final crossover at maximum output of the alternate waveform.

MAIN OUTCOME MEASURES

Successful conversion to another rhythm, number of shocks and amount of energy delivered to patients, and dermal injury.

MAIN RESULTS

The rates of successful conversion (cumulative success with increasing number of shocks) at each of the 3 shared energy levels (100, 150, and 200 J) were greater in the biphasic group than in the monophasic group (Table). After the fourth shock, the groups did not differ for successful conversion. The mean number of shocks delivered to each patient was lower in the biphasic group than in the monophasic group (1.7 vs 2.8, P < 0.001). Mean energy delivered to each patient was also lower in the biphasic group than in the monophasic group (217 vs 548 J, P < 0.001). Fewer patients in the biphasic group than in the monophasic group had dermal injury (Table).

CONCLUSION

In patients with atrial fibrillation, biphasic waveform shocks were more effective than monophasic waveform shocks for successful conversion to another rhythm.

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*See Glossary.

Biphasic waveform shock (BWS) vs monophasic waveform shock (MWS) for atrial fibrillation at termination of protocol†

Outcomes	Number of shocks (energy levels)	BWS	MWS	RBI (95% CI)	NNT (CI)
Successful conversion	1 (100 joules [J])	60%	22%	130% (60 to 280)	3 (3 to 5)
	2 (100, 150 J)	77%	44%	90% (40 to 170)	4 (3 to 6)
	3 (100, 150, 200 J)	90%	53%	110% (60 to 190)	3 (3 to 5)
	4 (BWS: 100, 150, 200, 200 J, MWS: 100, 150, 200, 360 J)	91%	85%	30% (–90 to 30)	Not significant
				RRR (CI)	NNT (CI)
Dermal injury		17%	41%	59% (34 to 75)	5 (3 to 9)

†Abbreviations defined in Glossary; RBI, RRR, NNT, and CI calculated from data in article.

COMMENTARY

Delivery of electrical energy to the chest wall to normalize cardiac rhythm has been a standard treatment for AF for nearly 40 years. Because the technique is safe and effective, it has changed little during that time.

To minimize the quantity of energy delivered and thus extend battery life, designers of devices for internal defibrillation of ventricular fibrillation found value in using biphasic waveforms. It is not surprising that device manufacturers have attempted to extend these findings and show superiority of this technique for external conversion of AF.

The study by Page and colleagues confirms previous research that the biphasic technique requires less current to be delivered. However, the 2 treatment groups did not differ for the overall conversion rate. The other important end point in the study, dermal injury, was not validated against patient perception, and it seems likely that "mild" dermal injuries would not be deemed clinically important by patients. If mild injuries were excluded, it seems there would be no difference in adverse effects between the 2 techniques. The investigators did not report on differences in an important predictor of outcome, chest wall impedance at baseline.

If we use a strict evidence-based approach, the biphasic waveform technique should not replace the monophasic technique as standard. However, it is possible that an appropriately powered study could show that biphasic energy delivery is associated with fewer failures and less postprocedure myocardial dysfunction.

There is no reason for practitioners to replace their current equipment. When deciding on new equipment, however, one might reasonably weigh the marginal additional cost of biphasic defibrillators against the low likelihood that such devices are inferior. It is also important to note that enthusiasm for converting patients in AF to normal sinus rhythm might wane in coming years, based on the finding of no benefit and potential harm associated with a "rhythm-control" strategy in the recently reported Atrial Fibrillation Following Investigation of Rhythm Management trial (1).

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Reference

1. **Coletta A, Thackray S, Nikitin N, Cleland JG.** Eur J Heart Fail. 2002;4: 381-8.