

# Is There a Need for Biphasic Energy Greater Than 200 Joules? An Evidence-Based Approach

Some external defibrillator manufacturers claim it is misleading to describe therapeutic doses in terms of energy, because it is current that defibrillates myocardium. Some also claim there is no need for biphasic shocks above 150 or 200 Joules (J). This paper will analyze these claims in light of basic principles of defibrillation and the best clinical evidence available.

## THE BASIC PRINCIPLE OF EFFECTIVE DEFIBRILLATION

*"...the essential requirement for electrical ventricular defibrillation is the attainment of a sufficient current density for an adequately long time in a substantial amount of the myocardium."* – WA Tacker<sup>1</sup>

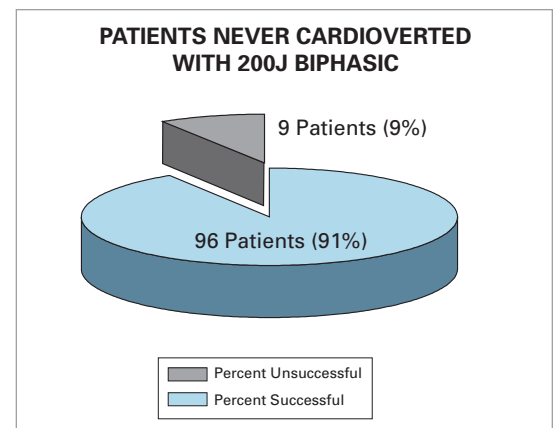
Effective defibrillation depends on having the right mix of several requirements—not on current alone. This mix is better represented by total energy which is a function of current and voltage (the force driving the current) over time. While the therapeutic agent is current, the therapeutic dose is best described in terms of energy (joules).

## CLINICAL EVIDENCE DEMONSTRATING THE LIMITATIONS OF LOW ENERGY

Numerous studies have analyzed the effectiveness of various biphasic energy doses in the treatment of atrial fibrillation (AF).<sup>2,3,4,5,6</sup>

One study, a 203 patient, double-blind, multicenter trial compared the Philips® SMART biphasic waveform (maximum 200J) with the Philips monophasic waveform. In that study **9% of the low energy biphasic patients were never successfully treated.**<sup>2</sup>

In response to the limitations of low energy biphasic therapy for difficult-to-treat patients, the authors of the study recommend that, "after one or two failed cardioversions with 200J biphasic waveform shocks, one might consider . . . double shocks or even catheter conversion" among other options. Similarly, a published review of this and other AF studies evaluating low energy biphasic waveforms, recommends ". . . using higher [biphasic] energies (150J, 200J, or greater) when AF has been present for longer periods."<sup>3</sup>



	Kim et al <sup>4</sup>	Al Atawi et al <sup>5</sup>	Neal et al <sup>6</sup>	Combined Results*
Medtronic 360J after failed ZOLL 200J	2/2	3/5	N/A	5/7 (71%)
ZOLL 200J after failed Medtronic 360J	0/2	0/2	0/1	0/5 (0%)

\*Statistically significant (Fishers exact test p=0.028)

There have also been a number of crossover studies comparing the effectiveness of low and full energy biphasic devices for the treatment of AF. They consistently demonstrate that there is a subset of difficult-to-treat patients that can be successfully cardioverted with higher energy settings even when they fail at 200J.<sup>4,5,6</sup>

## THE MEDTRONIC POSITION

In ventricular defibrillation and atrial cardioversion energy is a good descriptor of the therapeutic dose. Clinical evidence clearly demonstrates there is a subset of patients who can't be successfully treated with energy doses limited to 200J. Medtronic is committed to giving health care providers a full range of therapy choices with escalating 360J biphasic therapy for those difficult-to-treat patients.

1. Tacker, W.A., 1980. Electrical Defibrillation. Boca Raton, Florida: CRC Press, Inc.; p. 14
2. Page, R.L., et al. 2002. Biphasic versus monophasic shock waveform for conversion of atrial fibrillation: the results of an international randomized, double-blind multicenter trial. *J Am Coll Cardiol*. Jun 19; 39(12): 1956-63
3. Rho, R.W., Page, R.L., 2003. Biphasic versus monophasic shock waveform for conversion of atrial fibrillation. *Card Electrophysiol Rev*. Sep; 7(3): 290-1
4. Kim, M.L., et al. 2004. Comparison of rectilinear biphasic waveform energy versus truncated exponential biphasic waveform energy for transthoracic cardioversion of atrial fibrillation. *American Journal of Cardiology*; 94:1438-1440
5. Al Atawi, F., et al. 2003. Comparison of Biphasic Waveforms for the Transthoracic Conversion of Atrial Defibrillation: The Mayo Clinic Cardioversion Experience., *Circulation*: 108 IV-647
6. Neal, et al. 2003. Comparison of the efficacy and safety of two biphasic defibrillator waveforms for the conversion of atrial fibrillation to sinus rhythm. *American Journal of Cardiology*; 92: 810-14

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