

ACLS Defibrillation Protocols

With the ZOLL Rectilinear Biphasic Waveform

Introduction:

Most care providers are now familiar with the AHA Guidelines 2000 ACLS Algorithms for defibrillation which often refer to specific *monophasic* energy levels, or “the appropriate biphasic equivalent”. The purpose of this document is to outline the equivalent biphasic protocols specific to the ZOLL Rectilinear Biphasic Waveform.

	Monophasic				ZOLL Biphasic			
Synchronized Cardioversion	100J	200J	300J	360J	75J	120J	150J	200J
Defibrillation	200J	300J	360J	360J	120J	150J	200J	200J

The recommended protocols are based upon evidence presented in two prospective randomized clinical trials.

Synchronized Cardioversion

In a randomized multi-center trial¹, the data demonstrated superior results using the ZOLL Rectilinear Biphasic Waveform as compared to the monophasic waveform for both first shock and cumulative efficacy. There was a significant difference between the first shock efficacy of biphasic shocks at 70J of 68% and that of monophasic shocks at 100J of 21% ($p=0.0001$, 95% confidence interval of the difference of 34.1% to 60.7%). The results from this clinical trial therefore provide evidence to use 75J-120J-150J-200J as the recommended biphasic equivalent for any synchronized cardioversion procedure using the ZOLL Rectilinear Biphasic Waveform. Following the publication of this article, additional abstracts have also been presented showing statistically significant improvement over monophasic with energy settings as low as 5J with the ZOLL Rectilinear Biphasic Waveform^{2, 3, 4}

Defibrillation

In a second randomized multi-center trial⁵, the first shock, first induction efficacy of biphasic shocks at 120J was 99% versus 93% for monophasic shocks at 200J ($p=0.0517$, 95% confidence interval of the difference of -2.7% to 16.5%). The difference in efficacy between the rectilinear biphasic and the monophasic shocks was greater in patients with high transthoracic impedance (greater than 90 ohms). The first shock, first induction efficacy of biphasic shocks was 100% versus 63% for monophasic shocks for patients with high impedance ($p=0.02$, 95% confidence interval of the difference of -0.021% to 0.759%). The results of this study therefore provide evidence to use 120J-150J-200J as the recommended biphasic equivalent for any defibrillation protocol using the ZOLL Rectilinear Biphasic Waveform.

Other Arrhythmias

The use of the ZOLL Rectilinear Biphasic Waveform has not been studied in randomized prospective clinical trials for all types of arrhythmias covered by ACLS algorithms. Nonetheless, the following factors support using the biphasic energy equivalents for either Synchronized Cardioversion or Defibrillation as required:

1. AHA Guidelines 2000 state: *“Both monophasic and biphasic waveforms are acceptable if documented as clinically equivalent to reports of monophasic shock success”* (p I-164).
2. All ACLS algorithms which refer to electrical conversion specify either synchronized cardioversion or defibrillation, depending on the specific rhythm, and evidence for the ZOLL Rectilinear Biphasic Waveform exists for both synchronized cardioversion and defibrillation.
3. The ZOLL Rectilinear Biphasic Waveform has been documented as clinically equivalent or superior (in accordance with the AHA recommendation that the upper boundary of the 90% confidence interval of the difference between standard and alternative waveforms must be $<0\%$ ⁶) to reports of monophasic shock success in two separate prospective randomized clinical trials.

Note: The clinical results for the ZOLL Rectilinear Biphasic Waveform are based upon the use of ZOLL Multi-Function Pads. The combination of waveform, electrode properties and gel characteristics is essential to achieving efficacy results similar to those described above.

References

- ¹ Mittal et al Transthoracic cardioversion of atrial fibrillation. *Circulation*. 2000;101:1282-1287
- ² Niebauer et al Cardioversion thresholds of atrial fibrillation and atrial flutter using an external biphasic waveform defibrillator. Presented at NASPE 2000 (abstract)
- ³ Friedman et al Role of ibutilide and biphasic waveforms for cardioversion of atrial fibrillation in routine clinical practice. *PACE* 2002; 24:634 (abstract)
- ⁴ Schute et al. Rectilinear biphasic rather than monophasic waveforms for Transthoracic cardioversion of patients with rheumatic heart disease and longstanding atrial fibrillation after corrective mitral valve procedures. *Journal of the American College of Cardiology*. 2002;39:429A (abstract)
- ⁵ Mittal et al *Comparison of a novel rectilinear biphasic waveform with a damped sine wave monophasic waveform for Transthoracic ventricular defibrillation*. *Journal of the American College of Cardiology* 1999;34:1595-1601
- ⁶ Kerber et al, AHA Scientific Statement. *Circulation* 1997;95:1677-1682.