PHYSIO CONTROL

Annotated Bibliography: ADAPTIV™ Biphasic Technology

BIPHASIC VERSUS MONOPHASIC

Khaykin Y, et al. Biphasic versus monophasic cardioversion in shock-resistant atrial fibrillation: a randomized clinical trial. Journal of Cardiovascular Electrophysiology *2003: 14 (8): 868-872.**

All study patients were previously refractory to monophasic cardioversion. In this particularly difficult-to-cardiovert population, 61% of patients receiving a biphasic shock were cardioverted successfully, compared to 18% of patients who received a 360J monophasic shock ($p<0.001$). Furthermore, 44% of patients who failed to cardiovert with 150J, then 200J biphasic shocks, were successfully cardioverted with a subsequent 360J biphasic shock.

Neumann T, et al. Ambulatory electrocardioversion of atrial fibrillation by means of biphasic versus monophasic shock delivery. A prospective randomized study. Zeitschrift fur Kardiologie *2004: 93 (5): 381-387.*

When compared at equivalent energies up to 360J, ADAPTIV biphasic technology provided significantly greater cardioversion success than monophasic ($p<0.001$).

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van Alem AP, et al. A prospective, randomized and blinded comparison of first shock success of monophasic and biphasic waveforms in out-of-hospital cardiac arrest. Resuscitation *2003: 58: 17-24.**

At equal energy levels, ADAPTIV biphasic shocks resulted in resumption of an organized rhythm in a larger proportion of patients than monophasic shocks.

An initial 200J ADAPTIV biphasic shock terminated most VF episodes for at least 5 seconds (98%).

COMPARISON OF EFFICACY OF BIPHASIC WAVEFORMS

Al Atawi F, et al. Prospective, randomized comparison of two biphasic waveforms for the efficacy and safety of transthoracic biphasic cardioversion of atrial fibrillation. Heart Rhythm *2005: 2 (4): 382-387.*

There were no significant differences in efficacy between Medtronic ADAPTIV biphasic truncated exponential (BTE) and ZOLL® biphasic rectilinear (BRL) waveforms up to 200J. However, the BTE shocks cardioverted with less cumulative delivered energy than the BRL shocks (120 versus 157J, $p = 0.009$). Some patients who failed with BRL at its maximum 200J were cardioverted when crossed over to BTE at 360J. All ZOLL 200J crossover shocks were unsuccessful (5 total) after 360J failed to cardiovert.

Kim ML, et al. Comparison of rectilinear biphasic waveform energy versus truncated exponential biphasic waveform energy for transthoracic cardioversion of atrial fibrillation. American Journal of Cardiology *2004: 94: 1438-1440.**

At identical energies up to 200J, there was no significant difference in success between BTE and BRL technologies. Both patients who failed with BRL at its maximum 200J were cardioverted when crossed over to BTE at 360J.

Walker, et al. Comparison of six clinically used external defibrillators in swine. Resuscitation *57 2003: (1): 73–83.**

In difficult-to-defibrillate conditions, there were statistically significant differences between four biphasic waveforms, with ADAPTIV biphasic showing the highest efficacy.

(over)

FULL ENERGY/DOSE ESCALATION

Chapman, et al. Use of 360 joule biphasic shocks for initial and recurrent ventricular fibrillation in prehospital cardiac arrest. Circulation *2005: 112 (17): II-1112-1113.**

ADAPTIV biphasic shocks escalating from 200 to 360J terminated VF very well and were associated with good 30-day survival in the large cohort of patients with prehospital cardiac arrest. An initial 200J ADAPTIV biphasic shock terminated most VF episodes (92%). Escalation of the shock dosage to 360J in patients experiencing recurrent or persistent VF, was associated with effective VF termination (less than 0.5% of patients were unable to be defibrillated). Overall, 27% of all patients are known to have survived to 30 days. Of these, 50% received a 360J shock.

Niemann JT, et al. A model of ischemically induced ventricular fibrillation for comparison of fixed-dose and escalating-dose defibrillation strategies. Academic Emergency Medicine *2004: June: 11 (6): 619-624.**

In an experimental model of ischemically induced VF, escalating doses were more effective at terminating VF than fixed, lower-energy shocks ($p<0.002$).

Stiell IG, et al. The BIPHASIC Trial: A randomized comparison of fixed lower versus escalating higher energy levels for defibrillation in out-of-hospital cardiac arrest. Circulation *2007;115 1511-1517, Vol. 115, Issue 12; March 27, 2007.**

A triple-blinded, multi-center randomized controlled trial of 221 OOH cardiac arrest patients found that in patients who received more than one AED shock, an escalating higher energy protocol provided significantly higher rates of conversion to an organized rhythm (36.6% vs 24.7%, p=.035) and termination of VF (82.5% vs 71.2%, p=.027) compared to a fixed lower energy protocol.

Stothert JC, et al. Rectilinear biphasic waveform defibrillation of out-of-hospital cardiac arrest. Prehospital Emergency Care *2004: 8 (4): 388-392.**

Twelve percent of patients remained in VF throughout EMS treatment, when dose was limited to a maximum 200J biphasic rectilinear.

Walsh S, et al. Efficacy of distinct energy delivery protocols comparing two biphasic defibrillators for cardiac arrest. American Journal of Cardiology *2004: 94: 378-380.**

In a clinical trial comparing escalating and non-escalating BTE shocks, the escalating dose protocol provided a significantly higher rate of defibrillation by the third shock (83% versus 92%, p=0.03).

PEAK CURRENT/MYOCARDIAL DAMAGE

Niemann JT, et al. Intracardiac voltage gradients during transthoracic defibrillation: implications for postshock myocardial injury. Academic Emergency Medicine *2005: Feb: 12 (2): 99-105.*

Voltage gradient is a direct measure of the actual intensity of a shock and is associated with a likely mechanism of injury from shocks. The peak current and intracardiac voltage gradient produced by ADAPTIV 360J biphasic shocks were not different than those produced by ZOLL and Philips 200J biphasic shocks and lower than those produced by monophasic 150J shocks.

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Physio-Control
11811 Willows Road NE
P.O. Box 97006
Redmond, WA 98073-9706
USA
Tel: 425.867.4000
Fax: 425.867.4121