Clinical Summary

Defibrillation probability and impedance change between shocks during resuscitation from out-of-hospital cardiac arrest

Walker RB, Koster RW, Sun C, Moffat G, et al. Resuscitation 2009; 80:773-777.

Purpose:

To analyze AED defibrillation shocks from a large case series, evaluate the change in transthoracic impedance between shocks, and assess the variations in the probability of successful defibrillation.

Methods:

- Electronic records were downloaded from biphasic LIFEPAK® 500 AED files from out-of-hospital cardiac arrests from 3 EMS systems
- The records were analyzed to determine, for each shock, the impedance measurement and whether VF had been terminated by 5 seconds after the shock
- Per local protocols all patients received biphasic shocks of either 200J, 200J, 360J or 200J, 300J, 360J

Results:

- 863 out-of-hospital consecutive cardiac arrest cases were analyzed where AED defibrillation shocks were given
- 467 of the cases contained multiple shocks either because the first shock failed to convert VF (n=61) or because of recurrence of VF (n=406)
- Termination rates for VF were high both for first shocks (93%) and for all shocks combined (90%)
- The response of a patient to the first shock was indicative of the success/failure of subsequent shocks to that patient;
    - Patients successfully defibrillated by the first shock were successfully defibrillated by 93% of subsequent shocks, but
    - Patients not successfully defibrillated by the first shock were successfully defibrillated by only 69% of subsequent shocks
- Some patients were difficult to defibrillate: 5% of the patients accounted for 71% of the failed shocks
- Shock impedance changed by 1% and peak current by 1% in pairs of same energy 200J shocks, while shock impedance decreased by 4% and current increased 27% between 200J first shock and 300J second shocks

Conclusion:

- Contrary to common belief, impedance change between consecutive shocks of the same energy is minimal and not consistent
- Increasing the amount of current of a subsequent shock requires an increase of the energy setting
- Failed shocks are not randomly distributed. Failure of the first shock to defibrillate is often predictive of failure for subsequent shocks

Physio-Control Discussion Points:

The 2005 International Guidelines for CPR and Cardiovascular care (AHA and ERC) recognized that there were still unanswered questions regarding biphasic energy dosing and encouraged additional studies[1]. This study contains the largest set of out-of-hospital data ever collected documenting the behavior of biphasic waveforms, confirms some findings of previous studies published since the 2005 guidelines, and provides new insight into impedance changes between shocks, including:

- Impedance changes are minimal and inconsistent between shocks; the only way to reliably increase the amount of current delivered to the heart by the next shock is to increase the energy setting
- In over half the cases, more than one shock was required over the course of AED treatment. For the most part, this was due to recurrence of VF after initial defibrillation.
- Failed shocks are not randomly distributed. Failure of the first shock to defibrillate is often predictive of failure for subsequent shocks

- Defibrillation probability increased with increasing shock dose among the subset of patients who received shocks at each of the three energy levels—an observation consistent with the well-established defibrillation dose-response relationship[2] and a wealth of prior clinical data
- Physio–Control ADAPTIV™ biphasic shocks performed very well, with a first shock VF termination rate of 93% at 200J and an overall VF termination rate of 90% in 863 cases (1919 of 2124 shocks)

Physio-Control is committed to studying and reporting on the performance of the escalating energy ADAPTIV biphasic waveform used in LIFEPAK defibrillators in a variety of settings. Since the 2005 guidelines the majority of published studies documenting biphasic shock performance have been with Physio-Control ADAPTIV biphasic shocks escalating to 360J. It is hoped the insights gained will help clinicians make the most informed decisions regarding energy levels for optimal patient care in a variety of clinical settings.

REFERENCES

1. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2005;112: IV-37.

2. Tacker WA. Fibrillation causes and criteria for defibrillation. In: Tacker WA, editor. Defibrillation of the heart: ICDs, AEDs and manual. St. Louis, MO: Mosby; 1994. p.1-14.

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