IMMEDIATE COUNTERSHOCK FOR OUT-OF-HOSPITAL VENTRICULAR FIBRILLATION: *Elemental or Detrimental?*

Despite well-developed EMS systems with rapid response advanced life support (ACLS) capabilities, nationwide survival rates in the United States (U.S.) have remained bleak, even for out-of-hospital ventricular fibrillation (VF). Although these poor resuscitation rates have been attributed mostly to delays in CPR or defibrillation, recent laboratory and clinical data have also begin to suggest that the current standard of *immediately providing countershock may be detrimental* when VF has been prolonged beyond several minutes. Several studies now suggest that when myocardial energy supplies and oxygenation begin to dwindle with prolonged VF, *improvements in coronary artery perfusion must first be achieved* in order to prime the heart for successful return of spontaneous circulation (ROSC) after defibrillation. Providing countershock to an ischemic heart may be damaging as evidenced by histological and physiological studies. Therefore, in such situations, certain pharmacological and mechanical interventions might take precedence during resuscitative efforts, prior to countershock.

This concept may explain the lack of success for previous clinical studies of high dose epinephrine and other ALS procedures, which generally recommend multiple countershocks prior to drugs in the protocol, despite the corresponding pre-clinical studies that actually used the drugs prior to defibrillatory attempts. Several other animal studies now corroborate this concept of “drugs first” in prolonged VF. Even clinical studies have now begun to support this notion in terms of providing basic CPR for a short period prior to defibrillation in unmonitored out-of-hospital VF (i.e., typical case where there is a somewhat delayed response)

Unfortunately, this concept has not been totally elucidated and it also poses problems for current resuscitation policies. In addition to conflicting with internationally accepted standards, this evolving concept may also pose a glitch for current automated defibrillator initiatives (e.g., certain public access defibrillation initiatives).

Especially with well-performed, immediately executed basic CPR, successful defibrillation and ROSC can be achieved after prolonged periods of arrest. Oftentimes, drugs are never needed, even after the countershock. Therefore, somehow delineating between a hypoxic and non-hypoxic heart would be critical.

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Fortunately, successful defibrillation and ROSC may now be more predictable with real-time scoring of the VF waveform signal (for example, using on-line *electrocardiagraphic median frequency or scaling exponent analysis).* Conceptually, in a real-time setting, a defibrillator can perform an analysis of the VF waveform. If the score is high enough (or low enough depending on the analysis), a shock would be advised. If missing the mark, other therapies would be advised, at progressively different levels, depending on the severity of the poor score. Studies have shown that basic CPR and certain pharmacologic interventions can (but not always) improve the VF waveform score. While this overall concept appears to be very sound, there are multiple confounding variables including the sensitivity and specificity of the waveform analysis over time and its relationship to successful ROSC, as well as the type of energy and countershock delivered (e.g., low energy biphasic, high energy monophasic or other evolving delivery mechanisms). Nevertheless, this concept is compelling and will need aggressive, multi-approach studies to delineate the confounding variables.

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