Can a return of spontaneous circulation be achieved faster in a resuscitation algorithm that directs the duration of post-shock chest compressions according to the pre-shock value of the amplitude-spectral area?

A study of VF cardiac arrest in normal swine

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ABSTRACT

Background: We have previously demonstrated in a swine model of cardiac arrest due to ventricular fibrillation (VF) that a return of spontaneous circulation (ROSC) is achieved if the amplitude spectral area (AMSA) of the electrical waveform is less than 20 mV·Hz. AMSA is measured in real time to direct the duration of post-shock chest compressions. We hypothesized that such an algorithm would shorten the time needed to achieve ROSC in normal swine.

Methods: VF was induced electrically in normal swine and untreated for 10 minutes. Resuscitation was commenced with 1 minute of chest compressions, resuscitation of mechanical ventilation, followed by the first shock and administration of epinephrine. Subsequently, animals were randomized to a traditional or waveform guided group. In the traditional group, all shocks were followed by 2 minutes of post-shock chest compressions. In the waveform guided group, AMSA was measured prior to each shock and if AMSA <20 mV·Hz then post shock chest compression duration was shortened to 1 minute. AMSA was defined as a systolic aortic pressure greater than 50 mm Hg and pulse pressure >20 mm Hg lasting at least one minute.

Results: A total of 8 animals were assigned to the traditional group with 22 shocks delivered, and 8 animals to the waveform guided group with 21 shocks delivered overall. Time to ROSC was measured from the induction of VF. The traditional group had an average of 54±10.2 minutes to ROSC, while the waveform group had an average of 15±4.5 minutes to ROSC. Time to ROSC was compared with a Kruskal-Wallis rank test. The difference was found to be not statistically significant with a p-value of 0.2 (p=0.2).

Conclusions: A resuscitation algorithm that tailors the duration of post-shock chest compressions to the value of AMSA is feasible. In this small scale study the trend towards significant in both time to achieve ROSC and AMSA values for the waveform guided approach over the traditional approach of defibrillation.

METHODS

Ventricular fibrillation was induced with a 100Hz alternating current delivered through a pacing catheter in the right ventricle in normal swine and left untreated for 10 minutes. Resuscitation was commenced with 1 minute of chest compressions, resuscitation of mechanical ventilation, followed by the first shock and administration of epinephrine. Epinephrine was administered every 3 minutes after the first dose. Animals were then randomized to a traditional or waveform guided group. The traditional group followed the ACLS guidelines for resuscitation of all shocks followed by 2 minutes of post-shock chest compressions until ROSC is achieved or resuscitation efforts are stopped. In the waveform guided group, AMSA was measured prior to each shock and if AMSA <20 mV·Hz then post shock chest compression duration was shortened to 1 minute. AMSA was defined as a systolic aortic pressure greater than 50 mm Hg and pulse pressure >20 mm Hg lasting at least one minute.

RESULTS

A total of 8 animals (N=8) were assigned to the traditional group with 22 shocks delivered overall. A total of 8 animals (N=8) were assigned to the waveform guided group with 21 shocks delivered overall.

DISCUSSION

The results from this small scale pilot study are promising and show that a real-time assessment of AMSA to guide the duration of chest compressions is feasible. We found a small, but non-significant, reduction in the time to achieve ROSC in normal swine who were treated with the waveform guided approach over the traditional approach. We also found small, but non-significant, increases in the values of AMSA in swine treated with the waveform guided approach.

REFERENCES