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Reply letter to: Increasing CPR duration prior to first defibrillation does not improve return of spontaneous circulation or survival in a swine model of prolonged ventricular fibrillation

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Response to Drs. Sattur and Kern

We appreciate our esteemed colleagues', Drs. Sattur and Kern, interest in our work. We believe this model to be realistic, for 8 minutes of untreated VF is common in North America. [1] We demonstrated previously that one reason for the discrepancy between animal and clinical studies might be the difference in drug delivery timing. [2-3] Recent studies have altered cardiac arrest protocols to expedite drug administration with excellent results. [4]

Survival in this study is lower than we have previously reported. [5] We believe the discrepancy in outcomes between this study and our prior work is due to the vascular collapse that accompanies prolonged, untreated ventricular fibrillation (VF). Normally, we employ a drug cocktail including vasopressin (40 IU), epinephrine (0.1 mg/kg), propanolol (1.0 mg) and sodium bicarbonate (1.0 mEq/kg). In this study drugs were not administered because we intended to simulate first responder treatment with CPR and an AED. We also used a programmable resuscitation device that, at the time, did not allow us to do more than 15 chest compressions before a ventilatory pause. The more frequent interruptions of chest compressions in our study decreased mean CPP per epoch.

Importantly, there are several differences between our study and those cited by our colleagues. The work by Aufderheide *et al*. employed a 6-minute VF model. [6] Despite the shorter duration of untreated VF, they also noted a progressive diminution of CPP between 8 and 11.5 minutes in Table 4. It is possible that earlier CPR may delay this vascular collapse.

The work by Ewy *et al*. examined 3, 4, 5, or 6 minutes of untreated VF and administered drugs to 20 of the 31 swine in the 30:2 CPR group. [7] As data on the 11 swine that did not receive drugs are not separately presented, we encourage the reader to consider only the perfusing rhythm after first shock (Table 2) results as comparable to those in this study. Our present rate of ROSC in the 5 minute untreated VF group is higher than those reported by Dr. Ewy's group. Physiologically, our CPP results in the 5 minute VF group are similar, strengthening the validity of our model.

The study by Hayes *et al*. also employed an 8-minute untreated VF model. [8] As noted in Table 3, CPP in the standard ventilation group was 7 mmHg at 8 minutes VF and remained low throughout the first 14 minutes of resuscitation. Despite these poor CPP values, three animals went on to achieve ROSC. One possible reason for the difference in outcomes between

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our studies may be that drug rescue was provided at 14 minutes. In fact, their rate of ROSC (25%) is predicted by our prior modeling work assuming drug administration at 14 minutes post-arrest. [9]

Recent clinical data from the Resuscitation Outcomes Consortium demonstrate a drop off in the odds ratio of survival for patients receiving more than 195 seconds of CPR before rescue shock. [10] In conclusion, we agree that CPR alone after 8 minutes of untreated VF provides inadequate CPP. We recommend early CPR, but in the majority of cases where this does not occur, early drug administration along with excellent CPR is necessary for ROSC when VF has been prolonged.

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