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Resuscitation Science Symposium

Session Title: Session II: Best of the Best Oral Abstract Presentations

Abstract 5: 7.5% NaCl With Adenosine, Lidocaine and Mg²⁺ (ALM) improves Hypotensive Resuscitation in the Pressure-Controlled Rat Model of Severe Hemorrhagic Shock

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Much controversy exists over the fluid composition for hypotensive resuscitation. Previously we showed that a small volume of 7.5% NaCl/6% Dextran-70 (RescueFlow®) or 7.5% NaCl/hydroxyethyl starch (HES) led to cardiac instability and mortality (HES). Our aim was to examine the early resuscitative effects of 7.5% NaCl with adenosine, lidocaine and magnesium (Adenocaine™) (ALM) on mortality and hemodynamics in the rat model of severe hemorrhagic shock.

Methods: Male fed Sprague-Dawley rats (300–450g, n=48) were anesthetized and randomly assigned to one of six groups: 1) Untreated 2) 7.5% saline, 3) 7.5% NaCl/Mg²⁺ (M), 4) 7.5% NaCl with adenosine/Mg²⁺(AM), 5) 7.5% NaCl with lidocaine/Mg²⁺ (LM), 6) 7.5% NaCl with ALM. Hemorrhagic shock was induced by phlebotomy until MAP was 35–40 mmHg and continued for 20 min (~40% blood loss). Animals were left in shock for 60 min at 34°C. 0.3 ml (~ 3.5% of shed blood) was injected as a 10 sec intravenous (IV) bolus. Lead II ECG, arterial blood pressures, MAP, heart rate and rate-pressure product (RPP) were monitored.

Results: Untreated rats experienced severe arrhythmias and 38% mortality. There were no deaths in any treatment group. 7.5% NaCl alone failed to maintain MAP after 5 min. Interestingly, the presence of Mg²⁺ had a "colloid-like" effect, and at 60 min the MAP was 48±2 mmHg vs. 36±5 mmHg for the 7.5% NaCl group (P<0.05). In addition, the Mg²⁺ group showed a 25% higher RPP than 7.5% NaCl alone. 7.5% NaCl with ALM led to further increases in MAP and was significantly higher than all other treatment groups (MAP was 60 mmHg at 60 min; P<0.05). This higher MAP was associated with a twofold increase in diastolic pressure compared with 7.5% NaCl alone or AM or LM groups. Both 7.5% NaCl with AM or LM were mildly bradycardic but not when combined as ALM. A few arrhythmias occurred in 7.5% NaCl group with or without Mg²⁺, but no arrhythmias occurred in the other treatment groups.

Conclusions: 7.5% NaCl with ALM led to a significantly higher MAP (P<0.05), higher diastolic pressure, higher RPP and a more electrically stable heart compared with other treatment groups. Ultra-small (<1 ml/kg) intravenous bolus of 7.5% NaCl with ALM may have clinical applications in the early treatment of hemorrhagic shock on the battlefield or in out-of-hospital environments.

Author Disclosures: **H.L. Letson:** None. **G.P. Dobson:** Ownership Interest; Significant; Equity position in Hibernation Therapeutics. Consultant/Advisory Board; Significant; Consultant for Hibernation Therapeutics Global. Other; Significant; Sole inventor on nine (9) patents on Adenocaine™.

Key Words: Adenosine · Resuscitation · Ischemia reperfusion