Poster Number: 8

MetroHealth Medical Center

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Abstract Submission Form

Poster Title: **Novel Approaches to Mitigate Myocardial Metabolic and Electrolyte Derangements and Prevent PEA Rearrest**

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Location of Laboratory: **Rammelkamp 652**

Category: **Cardiac Physiology**

Background: Cardiac rearrest after return of spontaneous circulation (ROSC) is a significant barrier to successful resuscitation, making it a high priority for emergency care research. Regardless of initial arrest rhythm, rearrest is commonly due to pulseless electrical activity (PEA). However, mechanisms underlying PEA rearrest are poorly understood. Previously, myocardial contractile function during ischemia-reperfusion has been tied to alterations in extracellular sodium (Na+) and calcium (Ca2+) concentrations.

Objective: To determine physiological predictors and explore potential mechanisms underlying susceptibility to PEA rearrest.

Methods: Acute myocardial infarction (AMI) induced by left anterior descending artery (LAD) occlusion was followed by 8 min of VF, then pigs were resuscitated (defibrillation, CPR, epinephrine) to ROSC and the LAD was reperfused. Metabolic variables from arterial and coronary sinus (CS) venous blood gases, electrolytes, and hemodynamics were measured. Subjects that had PEA rearrest (n=9) were compared to those that did not rearrest (n=7).

Results: Arrest characteristics were similar between PEA and no rearrest groups, including ischemia duration and time to ROSC. At ROSC, hemodynamic and metabolic variables including pH, myocardial lactate consumption, myocardial arterial/venous oxygen difference were also similar between groups. Importantly, post-ROSC myocardial lactate consumption was significantly increased in the PEA group (3.5 vs. 0.5 mmol, $p<0.03$) as was coronary sinus Na+ (146 vs. 135 mEq/L, $p<.03$); however, coronary sinus Ca2+ was significantly reduced (1.9 vs. 2.3 mEq/L, $p<.03$). In additional experiments, (n=6) a reverse mode NCX blocker KB-R7943 (60 uM) given intracoronary at reperfusion prevented PEA ($p< 0.02$), raised CS Ca2+, lowered CS Na+ (both $p<0.04$), and normalized myocardial lactate consumption ($p<0.01$). Taken together, these data suggest that metabolic substrate depletion may promote local electrolyte shifts contributing to mechanical dysfunction underlying PEA and potentially mediated by NCX.

Conclusion: PEA rearrest was associated with increased myocardial lactate consumption and derangements in cardiac Na+ and Ca2+ in a translational model with well controlled arrest characteristics. Improved mechanistic based approaches to mitigate underlying post-ROSC electrolyte shifts may be a novel therapeutic approach to prevent and treat PEA rearrest.