**DETECTION OF ACUTE MYOCARDIAL INFARCTION USING A REAL-TIME CARDIAC ELECTRICAL BIOMARKER**  
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**Introduction:** The cardiac electric field is known to be dipoles such that 3 lead-vectors should describe the field. Eigenvalue modeling (EVA) of the 12-lead electrocardiogram (ECG) can quantify dipole vs. multipolar forces yielding a "cardiac electrical" biomarker (CEB) for detection of acute myocardial infarction (AMI). **Hypothesis:** The objective was to test a CEB model that quantifies the multipolar activity of the derived 12-lead ECG to detect AMI. **Methods:** This is a blinded, case-controlled study in which voltage-time ECG data arrays were analyzed from 102 patients with AMI and 248 patients with non-AMI. ECGs with missing leads, wandering baseline, and excessive noise were excluded. Simple optimization was used to derive the 12-lead ECG from just 3 basis lead-vectors (L1, L2, V2) stored in the cardiac monitor. The CEB was computed from the derived ECG by EVA to detect AMI and then compared to both an ECG interpretive algorithm (ECG), and to ST voltage changes (ST) consistent with AMI, assessed against the interpretations of the blinded physician reference standard. Sensitivities, specificities, and negative and positive predictive values were calculated. The 95% confidence intervals were computed for analysis of statistical significance. The measured vs. derived ECGs morphologies were compared using the Pearson correlation. **Results:** The CEB had a sensitivity of 88.0%, specificity of 91.3%, negative predictive value (NPV) of 95.0% and positive predictive value (PPV) of 80.2%. The ECG had a sensitivity of 54.3%, specificity 77.4%, NPV 80.3%, PPV 49.0%. The ST had a sensitivity of 59.5%, specificity 68.6%, NPV 80.7%, PPV 43.5%. The CEB showed superiority to the ECG and ST at p < 0.0001. The derived 12-lead ECG morphologies showed high correlation with the measured 12-lead ECG. **Conclusions:** The multipolar forces of the cardiac electrical field can be quantified from the derived 12-lead ECG to compute a CEB that reliably detects the presence of AMI. This cardiac "electrical" biomarker is readily computed directly from the patient cardiac monitor and displayed in real-time. This will allow an immediate, cost-effective, and efficient means of detecting AMI in patients who are being monitored in acute care settings.

**PRESENTATION OF ACUTE MYOCARDIAL INFARCTION SENSORS**  
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**Introduction:** To determine if ketone bodies are an effective metabolic substrate for the support of cardiac metabolism after resuscitation from severe hemorrhage shock. **Hypothesis:** A resuscitative fluid containing ketone bodies improves cardiac function in hemorrhagic shock. **Methods:** 48 hours prior to the hemorrhagic shock exposure, two groups (n = 7/group) of male Sprague Dawley rats were maintained on a high protein diet. Then the animals were anesthetized and cardiac metabolism was assessed by Positron Emission Tomography after injection of 18-Fluorodeoxyglucose (18-FDG; volume < 0.5 ml) in the tail vein. Scans were obtained at 60 and 120 minutes post-injection. The following day, the rats were again anesthetized and the femoral artery and vein were cannulated for measurement of hemodynamics, and sampling for blood gases, pH, base deficit, HCO3, glucose, Hgb, and oxygen saturation. After baseline measurements, arterial exsanguination was performed so that arterial pressure fell to 30-35 mmHg, and the shed volume was recorded. Data were recorded every 30' after induction of shock for 180'. Following 55' of hypotension, the animals were resuscitated with one of the following solutions 1) Hextend; 2) PEG-albumin; 3) MP40X, PEG-albumin served as a pegylated non-O2 carrying protein with matched COP. Whole body VO2 was measured from O2 content in inlet and outlet air of known flow rate with the rat in a sealed chamber. **Results:** Baseline VO2 was similar in all groups (20-25 ml/kg/min). Hemodilution was similar in all groups as reflected by the trajectory of hematocrit decline with time, falling to <5% after 70 min of ET. Hemodilution with either Hextend or PEG-albumin resulted in a rapid decline of VO2 (<4 ml/kg/min) at Hb below 4.2 g/dl, and mortality was 100% in both groups by 80 minutes, with terminal arterial lactate >21 mmol/L. Hemodilution with MP40X improved survival (87%), VO2 (11 ± 4 ml/kg/min), and arterial lactate (8 ± 2 mmol/L) at 160 minutes (1 hour after completion of ET). In follow up studies, rats that were initially hemodiluted with PEG-albumin for 40 minutes to a total Hb of 4.0 g/dl, followed by ‘rescue’ exchange transfusion with MP40X, exhibited intermediate survival times, VO2, and lactate concentrations. **Conclusions:** These data demonstrate that MP40X improves oxygen consumption compared to non-oxygen carrying plasma expanders and limits oxygen debt during extreme hemodilution. The data support the concept that MP40X, a high-affinity hemoglobin molecule, imparts significant benefit as an oxygen therapeutic agent.

**CHANGES IN SUBSTRATE UTILIZATION IN RAT HEARTS FOLLOWING HEMORRHAGE AND RESUSCITATION WITH KETONE SOLUTION**  
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**Introduction:** Glutamate cysteine ligase (GCL) is the rate-limiting enzyme for de novo glutathione synthesis. Polymorphisms within the genes encoding GCL can lead to decreased glutathione synthesis and increased host susceptibility to oxidant injury. **Hypothesis:** We hypothesize that an insertion/deletion polymorphism, located within the gene that encodes the catalytic subunit of the GCL enzyme, predisposes infants undergoing cardiopulmonary bypass (CPB) to oxidant injury. **Methods:** Infants undergoing CPB were genotyped using the Taqman Allelic Discrimination assay. Urine isoprostane concentrations, an indicator of oxidant stress, were measured from urine samples for infants undergoing CPB and compared between genotypes. To determine whether oxidants can directly affect pulmonary artery smooth muscle cells (PA SMC) and cardiac metabolism was assessed by Positron Emission Tomography after injection of 18-Fluorodeoxyglucose (18-FDG; volume < 0.5 ml) in the tail vein. Scans were obtained at 60 and 120 minures post-injection. **Results:** The CEB had a sensitivity of 88.0%, specificity of 91.3%, negative predictive value (NPV) of 95.0% and positive predictive value (PPV) of 80.2%. The ECG had a sensitivity of 54.3%, specificity 77.4%, NPV 80.3%, PPV 49.0%. The ST had a sensitivity of 59.5%, specificity 68.6%, NPV 80.7%, PPV 43.5%. The CEB showed superiority to the ECG and ST at p < 0.0001. The derived 12-lead ECG morphologies showed high correlation with the measured 12-lead ECG. **Conclusions:** The multipolar forces of the cardiac electrical field can be quantified from the derived 12-lead ECG to compute a CEB that reliably detects the presence of AMI. This cardiac "electrical" biomarker is readily computed directly from the patient cardiac monitor and displayed in real-time. This will allow an immediate, cost-effective, and efficient means of detecting AMI in patients who are being monitored in acute care settings.