Ischemia-Reperfusion Injury after CPR in Porcine Model of Severe Hemorrhagic Shock

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Introduction

- Previous studies in animals have shown that CPR is not beneficial and may be harmful in traumatic pulseless electrical activity (TPEA). TPEA occurs when a trauma victim's heart beats, but there is no central pulse due to loss of blood from hemorrhage.[1,2]
- Our lab previously showed that in a porcine model of severe hemorrhagic shock/TPEA, external chest compressions did not improve brain and skin perfusion; it also supported existing evidence that chest compressions lower diastolic blood pressure and do not raise overall mean arterial pressure.[3,4]
- Because the myocardium is supplied with blood during diastole, we hypothesize that a lower diastolic pressure may contribute to worse ischemia-reperfusion injury on the heart in CPR-treated TPEA victims compared to no-CPR-treated victims.
- Syndecan-1, a glycoprotein of the endothelium glycocalyx, is cleaved and released into the blood in ischemia-reperfusion injury. Thus, Syndecan-1 levels can be used as a biomarker of ischemia-reperfusion injury.[5]
- **In the present study, the extent of ischemia-reperfusion injury on the heart in no-CPR vs. CPR-treated TPEA swine was investigated by measuring Syndecan-1 levels in cardiac tissue samples.**

Study Design

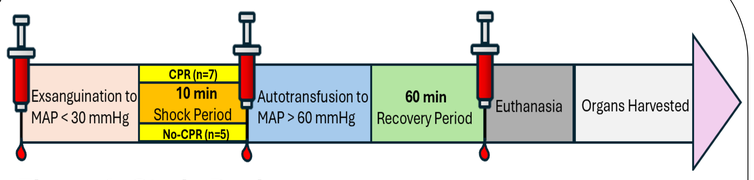

Figure 1. Study Design
Adult Female Yorkshire swine were exsanguinated to a mean arterial pressure (MAP) of < 30 mmHg to produce a state of severe hemorrhagic shock/traumatic pulseless electrical activity (TPEA). The pigs were randomly assigned to receive CPR or no CPR for a 10-minute shock period. After 10 minutes, CPR was stopped, and all pigs were autotransfused to a MAP > 60 mmHg. After a 60-minute recovery period, the pigs were euthanized, and their organs were harvested. Blood samples were also taken at 3 time points in the experiment: before exsanguination (baseline), after the 10-minute shock period, and after the 60-minute recovery period. The organs and plasma samples were stored in liquid nitrogen (-196 C) for future analysis.

Methods

- Wheat Germ Agglutinin (WGA) Stain of cardiac tissue
- Syndecan-1 Sandwich Enzyme-Linked Immunosorbent Assay (ELISA) of cardiac tissue homogenates

Results

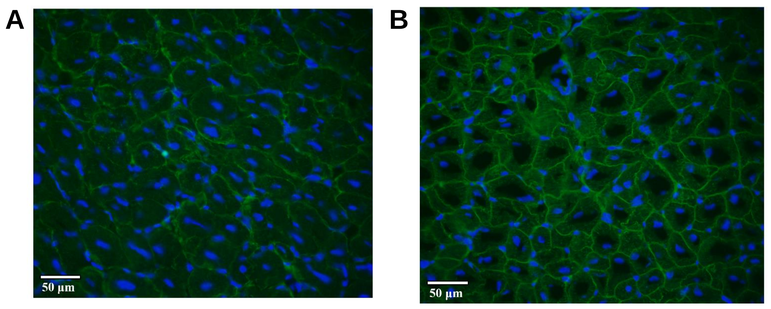

Figure 2. Wheat Germ Agglutinin (WGA) stain for glycoproteins (green fluorescence) with DAPI nuclear counterstain (blue fluorescence)
(A) Representative cardiac tissue sample from no-CPR group, 40X.
(B) Representative cardiac tissue sample from CPR group, 40X.

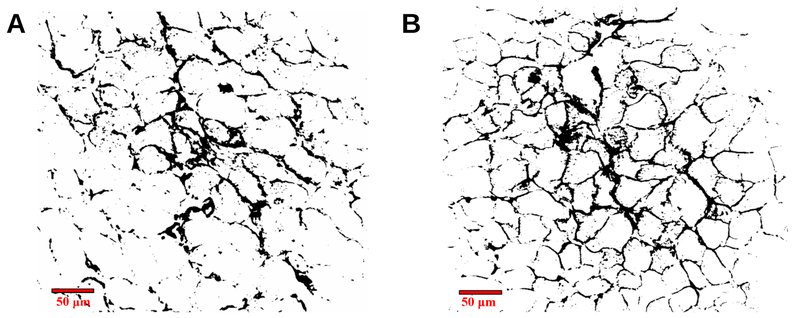

Figure 3. WGA stain fluorescence density
(A) Representative cardiac tissue sample from no-CPR group, 40X
(B) Representative cardiac tissue sample from CPR group, 40X.

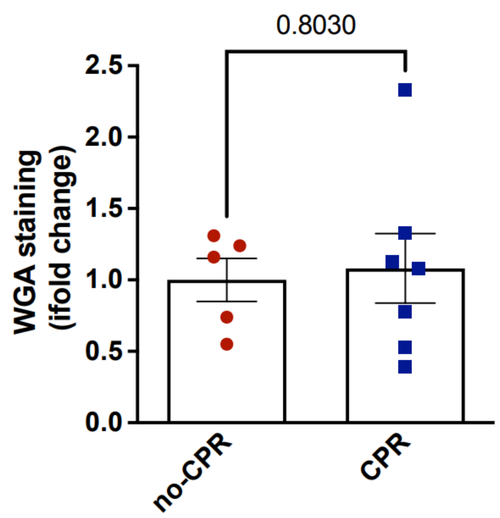

Figure 4. The WGA stain showed no significant difference between fluorescence densities of glycoprotein in the cardiac tissue
Comparison of WGA stain fluorescence density between no-CPR (n=5) and CPR group (n=7). Results analyzed with unpaired t-test, p = 0.8030. (p < 0.05 considered significant)

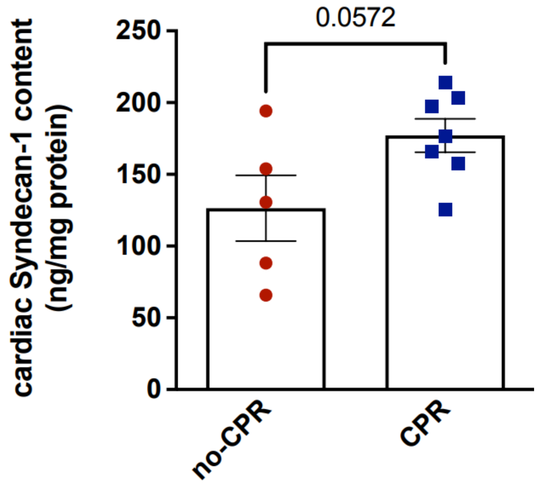

Figure 5. The Syndecan-1 Sandwich ELISA showed no significant difference between Syndecan-1 levels in the cardiac tissue homogenates
The amount of Syndecan-1 measured in each sample was normalized to the total protein content to give the results above. n=5 for no-CPR, n=7 for CPR. Results analyzed with unpaired t-test, p=0.0572. (p < 0.05 considered significant)

Conclusion & Future Directions

- With the current results, there is no significant difference between ischemia-reperfusion injury in the hearts of no-CPR and CPR-treated swine with traumatic pulseless electrical activity (TPEA).
- Further investigation will be done to measure Syndecan-1 levels in plasma samples of the specimens to compare global ischemia-reperfusion injury in the two groups.

References

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