Mechanical Tissue Resuscitation After Ischemic Injury to Cardiac Tissue

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Abstract

Mechanical tissue resuscitation (MTR) has emerged as a promising strategy for treating reperfusion injury after an acute myocardial infraction (MI). Specifically, the application of negative pressure to regions of tissue ischemia following reperfusion has been shown to greatly improve the overall outcome of ischemic tissues after reperfusion. A key variable determining the efficacy of treatment is the material used to construct the negative pressure patch. In this study, the application of two silicone based patches will be compared to a polyvinyl alcohol (PVA) patch and an untreated control. Defining parameters include the area at risk, infarct size, apoptosis and regional blood flow. Our study identified the PVA patch as having the greatest effect on infarct size, hemodynamics and blood flow. Future studies along this direction should investigate the efficacy of using the PVA patch with varying vacuum conditions and pressures.

Introduction

- Following MI, ischemic and reperfusion injuries are commonly reported
- A controlled application of negative pressure through mechanical tissue resuscitation (MTR) has been shown to improve outcomes during reperfusion
- MTR induces a physiological state through physical mechanisms that promotes cell survival
- MTR is unique from conventional, drug based treatments due to its ability to affect many different mechanisms of cell injury
- The material used to construct the MTR patch plays an influential role on the performance of the treatment
- The efficacy of a silicone based patch and a printed silicone patch was compared with a PVA patch and an untreated control

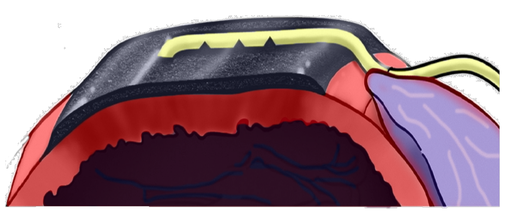
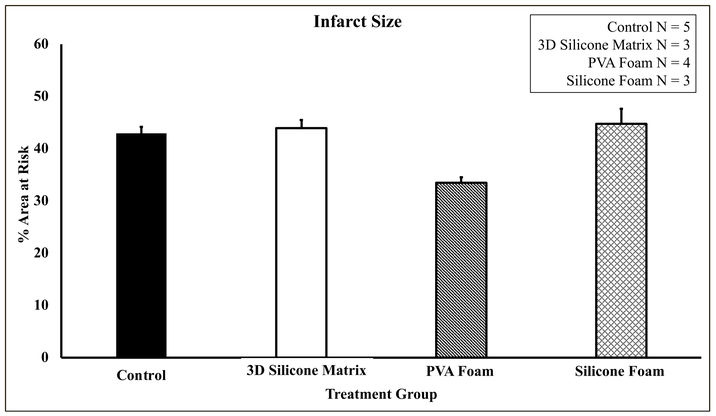
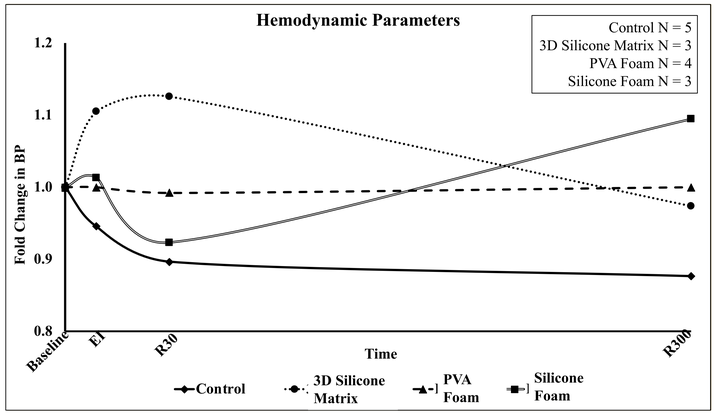
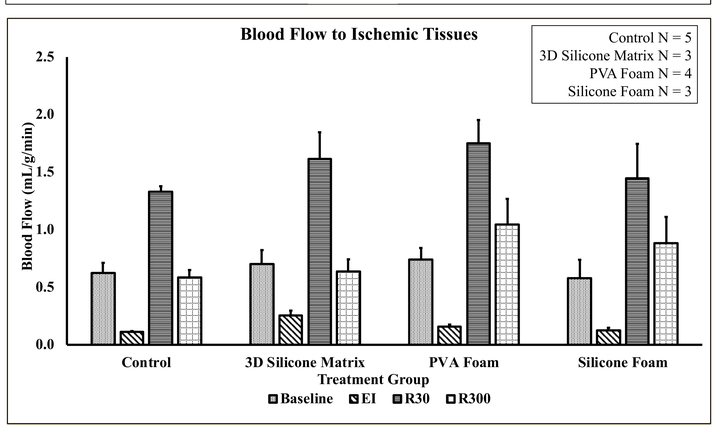


Illustration of MTR device (black) and heart (red + purple). Yellow signifies the vacuum tube connector

Results

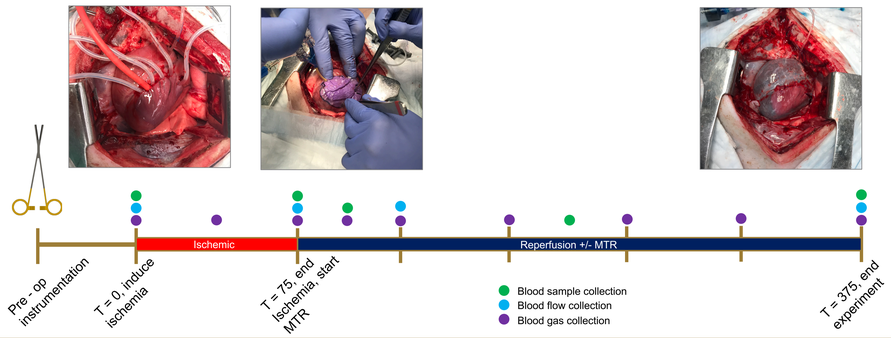






Surgical Methods

- Induction of anesthesia using ketamine and maintained on isoflurane
- Catheterization of both femoral arteries and a single jugular vein
- Median sternotomy provides access to the heart, cannulation of left atrium for administration of microspheres
- Reversible tourniquets tied around diagonals of LAD, induction of ischemia for 75 minutes
- Removal of tourniquets initiates the 300 - minute reperfusion period +/- MTR



Results and Conclusion

- Compared to control, the MTR strategy provides significantly improved outcomes when applied during reperfusion
- The PVA sponge demonstrated the greatest improvement on infarct size, systemic blood pressure and blood flow
- Application of the PVA sponge during reperfusion may allow for improved outcomes during recovery from MI
- Future studies should examine the efficacy of the PVA sponge when applied using various vacuum parameters and settings

Acknowledgements

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