**Introduction**: Transplantation of solid organs such as kidney, heart, and liver are now a standard procedure for the treatment of organ failure. Recent advances in surgical technique have provided promise for a similar therapeutic success in the transplantation of vascularized composite allografts (VCAs) such as limbs. Compared to solid organs, VCA transplantation involves multiple structures that may include skin, bone, muscles, blood vessels, nerves, and connective tissues. The state of the art for preserving these tissues is much less mature than that for internal organs. An important component of VCA preservation is the preservation of vascular function, suggesting that an improved understanding of blood vessel preservation would lead to improved VCA preservation. In addition to being vital for composite tissue survival, blood vessels are subjects of transplant in their own right. Therefore, we have initiated an investigation into optimal preservation solution composition for isolated blood vessels.

In this study, we aimed to test the effect of cold storage on the functionality of swine mesenteric arteries. Four cold storage solutions were tested: a) PBS, b) Krebs-Henseleit buffer, c) University of Wisconsin (UW) solution and d) a novel solution (HepatoSys solution, HS) that has been shown to restore function to livers from cardiac death donors that had been declined for transplant, such that they can be successfully transplanted.

**Materials and methods**: Swine mesenteric arteries were obtained from a regional abattoir and placed into PBS solution. Tissues were then transported to the laboratory on ice within 1 h. Vessels were cut into 5-mm length ring segments and stored in four cold solutions at 4 °C for up to 7 days. Each day rings were removed from the preservation solution and mounted in an organ bath for functional testing. Once stabilized, phenylephrine (10⁻⁵ M) was added into the organ bath to constrict the rings. Endothelium-dependent vasodilation was then tested by addition of ATP (10⁻⁸ to 10⁻⁵ M). Finally, sodium nitroprusside (10⁻⁴ M) was added to test endothelium-independent vasodilation.

**Results**: It was found that functional integrity in a large percentage of blood vessels could be maintained for up to 7 days, but was highly dependent on the solutions in which the rings were stored. As expected, PBS was ineffective in maintaining constriction resulting in failure after one day. UW solution was more effective in preserving constriction but was not significantly better than PBS in preserving endothelium dependent dilation. HS maintained function better than PBS, in particular, endothelium-dependent vasodilation with almost 50% responding to ATP even after 7 days. Surprisingly, Krebs-Henseleit solution containing glucose and O₂ gas provided protection of endothelium function, similar to that of HS (33.3% of rings stored in both solutions for up to 7 days displayed endothelium-dependent vasodilation).

**Conclusion**: It was possible to preserve vessel function, including endothelium-dependent vasodilation for as long as 7 days in cold storage. Given the demonstrated dependence of vascular function on storage solution compositions, these results provide an initial baseline for development of improved vessel preservation solutions for short-term cold storage and as a potential carrier solution for loading vitrification agents into tissues intended for long-term storage.