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RATE DEPENDENCY OF COLLAGEN HYBRIDIZING PEPTIDE ATTACHMENT TO VESSEL WALL COLLAGEN

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Traumatic brain injury (TBI) is an important contributing factor to injury mortality and creates a significant financial burden. Those who survive the immediate effects of TBI often face debilitating neurologic difficulties. Although many of the consequences of TBI are well understood, much is still unknown about the mechanisms of injury.

In order to more fully understand the loading of brain tissue during TBI, we utilized collagen hybridizing peptide (CHP) to mark damaged blood vessels in sheep brains subject to injury. CHP, developed by the Michael Yu group at the University of Utah, mimics the molecular structure of natural collagen and binds to damaged areas of a collagen fiber. We have recently shown that CHP binds to mechanically damaged collagen fibers in cerebral blood vessels[1].

Sheep brains were exposed to a controlled TBI, and vessels were extracted from the brain tissue. When stained with CHP and examined with fluorescent microscopy, these vessels, while showing unmistakable signs of mechanical damage, did not appear to have any attached CHP. These results were inconsistent with previous results shown in our lab, with the only obvious difference being the rate at which the vessels were deformed. In order to further investigate this observation, cerebral arteries were obtained from a lamb, and randomly sorted into two groups. One group was stretched at quasi-static loading rates, while the other was subject to strain rates of at least 50 s^{-1}. These vessels were stained with CHP, and damage was quantified according to procedures established by the Monson group, in which the metric for damage is defined as the percent bright pixels.

There was a significant difference in CHP attachment between the two groups. The vessels pulled at a quasi-static rate displayed an average of 12.8% bright pixels, while those in the high rate group displayed an average of only 0.8% bright pixels. These results are consistent with the findings in the controlled sheep TBI, in which vessels were loaded at a high rate. Although these results indicate that CHP may not be applicable to high rate TBI studies, it does suggest an interesting avenue for further research. The differences seen in the lamb vessels could indicate that loading rates may have significant impact on stress wave propagation and failure mechanisms in cerebral vessels. Future research will include a larger scale study investigating this phenomenon in porcine cerebral arteries.

[1] Converse, Matthew I., et al. "Detection and characterization of molecular-level collagen damage in overstretched cerebral arteries." *Acta biomaterialia* (2017).