

Dr. Kelso's primary research interest is developing novel pharmacological agents for the treatment of traumatic brain injury (TBI). Dr. Kelso's lab utilizes *in vitro* and *in vivo* models of head injury to study the biochemical pathways (secondary injury) that are initiated by the mechanical trauma (primary injury). Dr. Kelso uses biochemical, histological, and behavioral techniques to study both the pathophysiology of a TBI and the effects of drug treatment. Currently, there are three projects underway in the lab:

1. Efficacy of superoxide dismutase polymer formulations for the treatment of oxidative damage induced by traumatic brain injury. In collaboration with Dr. Alexander Kabanov, Center for Drug Delivery and Nanomedicine we are developing a novel therapeutic formulation of copper zinc superoxide dismutase (also referred to as SOD1) for the treatment of TBI. Free radical production and the resulting oxidative stress is a significant injury mechanism following TBI. By delivering exogenous SOD1 to the brain, we may be able to attenuate neuronal damage. This project will utilize MRI, behavioral tests, histology, ELISA, and native gel electrophoresis.

2. Macromolecular prodrug for emergency treatment of trauma brain injury. In collaboration with Dr. Dong Wang, Department of Pharmaceutical Sciences we are developing a prodrug of a lipid peroxidation inhibitor. This prodrug produces decreased toxicity and pH sensitive release allowing for improved drug targeting. This project will utilize MRI, behavioral tests, histology, and flow cytometry.

3. Magnetic resonance elastography of a traumatic brain injury mouse model

The use of neuroimaging methodologies for injury classification following TBI is necessary for guiding treatment options. Most studies rely on the widely used Glasgow Coma Scale for study inclusion which does not reveal information regarding the underlying pathology. In collaboration with Dr. Shadi Othman, Biological Systems Engineering, University of Nebraska-Lincoln, we are developing magnetic resonance elastography (MRE) for revealing information regarding the structure, composition, and function of the brain following TBI.

4. Effect of protective devices on the brain trauma mechanics under idealized shockwave loading.

Advances in protective body armor and changes in combat tactics of enemy combatants in Iraq and Afghanistan have led to a dramatic increase in the number of U.S. military personnel sustaining a TBI. Dubbed "the signature wound of the Iraq war", TBI and its consequences are presenting multiple challenges to military medicine. The effects of the shockwave resulting from an explosive blast are only beginning to be understood. In collaboration with Dr. Namas Chandra, Mechanical and Materials Engineering, University of Nebraska-Lincoln, we are studying the effects of a primary blast wave on oxidative stress and neuronal degeneration.