

New Technology To Save Soldiers From Blast Brain Injury

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Researchers from the University of Maryland School of Medicine (UMSOM) and the University of Maryland School of Engineering have developed a new military vehicle shock absorbing device that may protect troops from traumatic brain injury (TBI) after a landmine blast. Over the past 18 years of conflicts in Iraq and Afghanistan, more than 250,000 troops have suffered such injuries.

The research, conducted jointly by Gary Fiskum, PhD, M. Jane Matjasko Professor for Research and Vice-Chair, Department of Anesthesiology at UMSOM, and William Fourney, PhD, Keystone Professor of Aerospace and Mechanical Engineering and Director of the Dynamic Effects Laboratory.

Prior to this study, according to spacedaily.com, most research in this area focused on the effects of rapid changes in barometric pressure, also known as overpressure. "This is the only research so far to model the effects of under-vehicle blasts on the occupants," said Dr. Fiskum. "We have produced new insights into the causes of TBI experienced by vehicle occupants, even in the absence of significant pressure changes." The research has led to the development of materials and vehicle frame design that greatly reduce injury caused by under-vehicle explosions.

Dr. Fiskum and Dr. Fourney were the first to demonstrate how the enormous acceleration (G-force) that occupants of vehicles experience during under-vehicle blasts can cause mild to moderate TBI even under conditions where other vital organs are unscathed.

"Intense acceleration can destroy synapses, damage nerve fibers, stimulate neuroinflammation, and damage the brain's blood vessels," said Dr. Fiskum. The researchers also elucidated the molecular mechanisms responsible for this form of TBI.

Dr. Fourney's team has developed highly advanced shock absorber designs that incorporate polyurea-coated tubes and other structures to reduce the blast acceleration experienced by vehicle occupants by up to 80 percent.

"Essentially, it spreads out the application of force," Dr. Fourney said. "Polyurea is compressible and rebounds following compression, resulting in an excellent ability to decrease the acceleration."

These results were combined with those of Dr. Tchantchou, who demonstrated that mitigation of g-force by the elastic frame designs virtually eliminates the behavioral alterations in lab rats and loss of neuronal connections observed using small scale vehicles with fixed frames.

Continued collaboration between the labs of Drs. Fiskum and Fourney has the potential to lead to the next generation of armor-protected military vehicles that will further protect occupants. An important next step will be testing a larger scale model. "If the data holds up for those, it will hold true for full scale," Dr. Fiskum said.

"Given the complexities of today's global health challenges, innovative discoveries are increasingly coming from the collaboration between disciplines, such as medicine and engineering," said E. Albert Reece, MD, Executive Vice President for Medical Affairs, UM Baltimore, and the Dean, University of Maryland School of Medicine. "We are proud that the School of Medicine is working in partnership with other entities across the University System of Maryland, so that we can maximize the impact we are having."