New York Times  
May 17, 2012   
Pg. 14

**Brain Ailments In Veterans Likened To Those In Athletes**

By James Dao

Scientists who have studied a degenerative brain disease in athletes have found the same condition in combat veterans exposed to roadside bombs in Iraq and Afghanistan, concluding that such explosions injure the brain in ways strikingly similar to tackles and punches.

The researchers also discovered what they believe is the mechanism by which explosions damage brain tissue and trigger the wasting disease, called chronic traumatic encephalopathy, or C.T.E., by studying simulated explosions on mice. The animals developed evidence of the disease just two weeks after exposure to a single simulated blast, researchers found.

“Our paper points out in a profound and definitive way that there is an organic, structural problem in the brain associated with blast exposure,” said Dr. Lee E. Goldstein of Boston University’s School of Medicine and a lead author of the paper, which was published online Wednesday by the peer-reviewed journal Science Translational Medicine.

The paper provides the strongest evidence yet that some and perhaps many combat veterans with invisible brain injuries caused by explosions are at risk of developing long-term neurological disease — a finding that, if confirmed, would have profound implications for military policy, veterans programs and future research.

The study could provide a starting point for developing preventive measures for blast-related brain injuries, as well as drug therapies and diagnostic tests for C.T.E., an incurable disease detected only by autopsy.

“The animal model developed by the researchers will enable a better understanding of the brain pathology involved in blast injuries and, ideally, lead to new therapies to help service members and veterans with traumatic brain injuries,” said Dr. Joel Kupersmith, the chief research and development officer for the Department of Veterans Affairs, which helped finance the research.

The paper also seems likely to fuel a debate that has raged for decades over whether veterans who struggle emotionally and psychologically after returning from war suffer from psychiatric problems or brain injuries.

Dr. Goldstein and his co-lead author, Dr. Ann McKee, co-director of the Center for the Study of Traumatic Encephalopathy at Boston University, assert that their paper shows that many of those veterans probably have organic brain injuries and should be given appropriate treatment and disability compensation.

“Not long ago, people said N.F.L. players with behavior problems were just having problems adjusting to retirement,” Dr. Goldstein said. “Now it’s more or less settled that there is a disease associated with their problems. But we do not have that consensus in the military world yet.”

Since 2001, the military has confirmed traumatic brain injury — widely considered the precursor to C.T.E. — in more than 220,000 of the 2.3 million troops who have served in Iraq and Afghanistan, though some experts believe the actual number is higher. There is no way yet of estimating how many of those combat veterans may develop the disease.

Some experts who have read the paper questioned the authors’ conclusions, saying that there was not enough data to conclude that blast exposure leads to C.T.E. Dr. McKee autopsied only four veterans, and three of them had head injuries from multiple sources, making it hard to determine the cause of the disease, they said.

“It’s too small of a sample size,” said Dr. David Hovda, director of the Brain Injury Research Center at the University of California, Los Angeles, and a health adviser to the Pentagon.

But Dr. Hovda said that the growing body of research linking C.T.E. to multiple head injuries was “quite remarkable.”

Dr. Daniel P. Perl, professor of pathology at the Uniformed Services University of the Health Sciences, the military’s medical school, said the study did not convince him that the injuries from blast exposure were identical to head injuries from sports, and he questioned whether data from the mouse research was applicable to humans. But Dr. Perl, who has just started his own project to study the brains of military personnel, called the paper “an important contribution.”

While acknowledging some issues in using mice, Dr. McKee said that animal tests helped resolve a problem scientists face in studying C.T.E.: human patients typically suffer concussions in several ways, whether from car accidents, sports or combat. With mice, the researchers could ensure that the brain damage was caused solely by blast exposure.

C.T.E. causes neurological decay and is linked to memory loss, personality changes, impaired judgment, depression and dementia. A once obscure disorder thought mainly to afflict boxers, it has entered the popular lexicon in recent years as more athletes have received the diagnosis, including David Duerson, the former All-Pro defensive back for the Chicago Bears, who killed himself last year.

The new study out of Boston is just the second time scientists have found C.T.E. in combat veterans. Last fall, a team of researchers led by Dr. Bennet Omalu discovered evidence of the disease in a 27-year-old Iraq war veteran who committed suicide in 2010. The former Marine had reported being close to mortar blasts and roadside bombs in Iraq, but also experienced multiple concussions from contact sports.

Dr. Omalu, the chief medical examiner for San Joaquin County, Calif., said he was preparing another paper documenting C.T.E. in eight veterans who had received diagnoses of post-traumatic stress disorder before they died.

Dr. McKee, who directs a brain donation center at the Department of Veterans Affairs medical center in Bedford, Mass., said it took her four years to gain access to the brains of the four veterans. Three of the veterans had single or multiple exposures to blasts, while a fourth had multiple concussions from football and vehicle accidents.

She compared tissue samples from those veterans with the brains of four athletes — three amateur football players and a professional wrestler — three of whom reported multiple concussions and all of whom died in their teens or 20s. She also studied the brains of four people with no record of concussions.

In all the veterans and athletes, Dr. McKee found the signature evidence of early phase C.T.E.: dead or dying neurons, abnormal clumps of a toxic protein and damaged axons, the fibers that transmit signals between nerve cells. She found no evidence of the disease in the people with no reported concussions.

For the animal part of the study, Dr. Goldstein developed a 27-foot-long “shock tube” to simulate explosions. At one end of the aluminum tube the researchers attached a device that uses compressed nitrogen to explode a Mylar membrane, generating force equal to the explosion of a 120-millimeter mortar round. At the other end, they tied down mice, allowing their heads to move freely.

The researchers found that shock waves from the blast moving at more than 1,000 miles per hour had no perceptible effect on brain tissue. But the subsequent blast wind, traveling at 330 m.p.h., shook the skull violently in what the researchers called “bobblehead effect.”

When the scientists examined specially stained tissue from the mouse brains under microscopes just two weeks later, they found the telltale signs of C.T.E.

The scientists also found that mice exposed to blasts showed short-term memory loss and declines in learning capacity just a few weeks later.

But when the researchers immobilized mouse heads during blasts, the mice did not develop learning problems later, suggesting that the brain trauma might be blocked by preventing the head from snapping around during an explosion.

Dr. Hovda said that one implication of the study might be that “traumatic brain injury is not an event that we recover from.”

“Maybe it is the beginning of a series of events that we have to deal with for years,” he said.

As devastating as that news may seem, it may also provide comfort to some military families.

Jennifer Smith, the widow of Michael Smith, the Marine found to have C.T.E. by Dr. Omalu, said she had gained a better understanding of his suicide after researchers told her his emotional problems might have been the result of a brain injury.

In an interview, Ms. Smith said that after her husband returned from his second tour of Iraq in 2009, he had nightmares and mood swings and seemed angry much of the time. (He also had a concussion from playing football in that period.)

Before he hanged himself in 2010, doctors gave him a diagnosis of post-traumatic stress disorder and put him on antidepressant drugs, to no avail, she said.

“He had no control over it,” she said, referring to C.T.E.