

# Baseline Intelligence Best Predicts TBI Outcome

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WASHINGTON — High intelligence may be protective against brain injury—associated cognitive dysfunction, judging from follow-up data on veterans injured during the war in Vietnam, Jordan Grafman, Ph.D., said at a meeting sponsored by the Institute of Medicine.

Dr. Grafman, chief of the cognitive neurosciences section of the National Institute of Neurological Disorders and Stroke, presented new data from 35 years of following Vietnam War veterans with traumatic brain injury (TBI). The study is the most recent phase in the ongoing Vietnam Head Injury Study, a long-term follow-up of veterans who suffered head injuries in combat. The cohort included 199 men with TBI and 55 controls; their average age at most recent follow up was 59 years.

Participants completed a variation of a U.S. Army classification test used to assess

mental ability. The test was similar to an intelligence test that the soldiers took when they first enlisted. Overall, 4.5% of the participants scored less than 24 on the Mini-Mental State Examination, but those who scored lower also had below-average baseline intelligence scores.

The controls showed a cognitive decline with age, and the soldiers with penetrating head injuries showed a slightly greater decline, even when investigators controlled for a host of variables.

“But if you look at subgroups, those with the lowest preinjury intelligence scores had the most cognitive decline from preinjury to follow-up, and the difference was statistically significant, compared with controls,” Dr. Grafman said. He also noted that soldiers with head injuries who show exacerbated cognitive decline as they age may be mistakenly diagnosed with dementia, when in fact their increased cognitive decline results from a combination of aging and the size of their lesions.

Based in part on these findings, Dr. Grafman does not believe that TBI is always a precursor to Alzheimer’s disease. But the long-term findings suggest that the location of the injury contributes to late-life cognitive decline and other symptoms.

“Lesions of the caudate nucleus of the brain significantly and consistently predicted late-life cognitive decline, and may indicate the importance of certain neurotransmitters in maintaining functions as we age,” Dr. Grafman said.

By contrast, the location of a TBI can be protective, too. Posttraumatic stress is clearly part of the experience of war, especially if someone experiences combat, Dr. Grafman said. But none the men with injuries to the amygdala showed signs of posttraumatic stress disorder, whereas 18% of those men with ventromedial prefrontal cortex lesions and more than 40% of patients with lesions elsewhere in the brain had developed PTSD over time since their injuries.

Dr. Grafman emphasized the importance of longitudinal studies for brain injury patients in general, and for veterans in particular, because baseline data are often available. “Preinjury intelligence is by far the best predictor of outcome, no matter what other variables you throw in,” Dr. Grafman said, based on the 35-year data and data from the same group of veterans at 5 and 15 years’ follow-up. Data gathered on the cohort at 10 years showed individuals who scored higher on baseline intelligence tests were more likely to be working years later, and they were more able to handle daily activities, compared with those who had lower baseline intelligence scores.

Veterans are an outstanding patient group, and a systematic plan is needed to keep them from being lost in the medical system, Dr. Grafman noted, adding, “There needs to be a well-run centralized database for the registry of head-injured soldiers with a small number of manageable variables.” ■

## Blast-Induced Brain Trauma Inflicts Heavy Emotional Wound

WASHINGTON — All traumatic brain injuries are not equal. Soldiers who experience blast-induced brain trauma manifest significantly greater emotional upheaval than do soldiers with brain injuries caused by car accidents, judging from preliminary data on soldiers wounded while deployed in Iraq.

In presenting the data at a meeting sponsored by the Institute of Medicine, Louis French, Psy.D., said, “At least one of the things that differentiates blast-induced brain injury from other types of mechanically induced brain injury is how emotionally traumatic the event is for these people. Perhaps blast as a mechanism is a more difficult way to get hurt emotionally.”

Dr. French presented some preliminary data from 144 soldiers who returned from Iraq with traumatic brain injury (TBI) who had completed the neurobehavioral symptom inventory prior to deployment. Most (141) were men, and the average age was 30.5 years. The symptoms included emotional, cognitive, and functional. The soldiers rated the symptoms as to how problematic they were.

A total of 130 patients had suffered closed head injuries, and 108 (75%) were injured from a blast. A total of 62 patients were classified as having mild TBI. In those 62 patients, the most common problems were sleep disturbances (94%—of which 33% have reported very severe sleep disturbances), forgetfulness (89%), and irritability (81%). The soldiers were treated at Walter Reed Army Medical Center in Washington, where Dr. French is on the staff of the Defense and Veterans Brain Injury Center.

There may be something different about a blast injury that introduces a certain type of symptom, he said.

The people who have been injured from blast were endorsing higher levels of symptom severity than were people who were injured through other ways, he noted.

The three statistically significant symptoms that differentiated the blast injury patients were anxiety, depression, and frustration tolerance, all of which came out of the emotional cluster of symptoms.

Soldiers with TBI are dealing with more than neurologic impairment and emotional symptoms resulting from their TBI. They also are facing problems such as chronic pain, stress, ongoing physical rehabilitation, and dramatic lifestyle changes all brought on by the TBI, Dr. French said in an interview.

During his presentation, Dr. French also offered data to highlight the epidemiology of TBI in military personnel, along with some sample characteristics, symptoms, and tips for how community neurologists might

### High Pressure Is the Driving Force in Blast Injury

**B**last injuries are caused by the explosion’s blast waves—fronts of high pressure that compress the surrounding air, said Dr. Ibolja Cernak at a meeting sponsored by the Institute of Medicine.

Behind the blast wave is the blast wind, which causes a massive displacement of air that can reach hurricane proportions, said Dr. Cernak, medical director of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md.

The interaction of the blast wave and blast wind in a battle-ground setting can cause several types of brain injury:

► **Primary.** Injury caused by the

direct effect of blast pressure on the brain tissue.

► **Secondary.** Injury that occurs when the blast propels flying objects (such as shrapnel) into a person.

► **Tertiary.** Injury that occurs when the blast propels a person through the air to strike an object (similar to when someone is thrown from a car during a car accident).

► **Quaternary.** Injury caused by other effects of a blast, such as burns from thermal bombs or crush injuries caused by falling debris after a blast.

Dr. Cernak noted research find-

ings have shown that blast injuries are part of a complex trauma as the whole body responds to a dramatic environment, she said. Blast injuries to the brain can be direct (when the force of the blast causes the brain to impact the skull or spine) or indirect (when the brain responds to the shock of impact on other parts of the body).

Soldiers in combat settings regularly are exposed to blasts. Even if they do not immediately and obviously show signs of a traumatic brain injury, repeated exposure to low-level blasts may cause brain injuries to develop over time, Dr. Cernak noted.

evaluate and treat these patients once they leave intensive care facilities. “While there has been a lot of attention to brain injuries in the military, we need to be cautious about making a diagnosis based on symptoms without knowing the timing of an event,” he said.

For a patient’s symptoms to be related to a TBI, he or she needs to experience a traumatic event—such as a car accident or a blast injury—that creates an external force to the head and causes an alteration in brain function, at least a brief feeling of being dazed and confused, or a complete loss of consciousness.

Although some symptoms may manifest much later than the TBI, there will be some symptoms that occur immediately at the time of the TBI, if that is the true cause of the symptoms, Dr. French explained.

Depression is a good example of a symptom experienced by many soldiers that may or may not be related to their TBI. “We know that depression is a fairly common symptom following TBI. However, the depression may be related to the blow to the head itself or to the fact that someone can’t work for a while or can’t return to fighting,” Dr. French said.

Explosion and blast-related injuries are a significant problem among military returning from the war in Iraq, accounting for 68% of injuries among 433 wounded sol-

diers treated at Walter Reed between January 2003 and April 2005, Dr. French said. Of these, 89% were closed head injuries; 43% of the patients suffered posttraumatic amnesia of less than 24 hours (*J. Neurotrauma* 2005;22:1178).

Complications among the TBI patients while they were treated at Walter Reed included skull fractures (25%), subdural hematoma (18.7%), shock (14%), and hypoxia (9.5%). In addition, 91% reported postconcussive symptoms including headache (47%), forgetfulness (46%), irritability (45%), and problems concentrating (41%). Overall, 43% had psychiatric symptoms, 27% of which were depression related.

Dr. French and his colleagues developed a blast injury protocol to evaluate the soldiers with follow-ups at various intervals. The protocol calls for not only basic medical care but also physical therapy and psychotherapy, as well as treatment for cognitive problems and chronic pain.

“It’s important to remember [that soldiers who have returned from Iraq with blast-induced TBI face] issues of chronic pain, ongoing physical rehab, ongoing stress symptoms, and a change in life roles,” Dr. French said, adding basic medical care, such as treating headaches and sleep problems, can go a long way toward making these patients more comfortable during a lengthy, ongoing recover. ■