Start by envisioning a bowl of jello. Tap it on one side and watch how it wiggles all the way over to the other. This mundane image actually demonstrates the force of a blast wave — from a bomb, an improvised explosive device (IED), a mine, grenade or mortar shell — traveling through brain matter, disrupting pathways and unleashing a chemical soup on its victim, according to Jonathan Fellus, MD, UMDNJ- New Jersey Medical School assistant professor and Director of Brain Injury Services at Kessler Institute of Rehabilitation.

Just the first of several possible onslaughts to a soldier's body in battle, sometimes the blast wave leaves no outward physical manifestation of the devastation within. Traumatic brain injury (TBI) has been called the “signature wound” of the Iraqi and Afghanistan conflicts, probably because it accounts for a larger proportion of troop casualties than in previous American wars. What’s frightening is that, according to the United States military’s own statistics, 20 percent of all returning veterans may have some degree of brain injury.

Fellus has seen the results up close and personally in his patients, learning from them and for them. “Unfortunately, because of the war, we are riding a tremendous wave of knowledge in this field. I like to think of myself as a bit of a mad scientist, who tinkers and experiments. But if you aren’t creative and gutsy, then you don’t belong in brain injury rehabilitation.”

A passionate neurologist with an incisive understanding of pharmacology, he is charged with the hands-on care of brain injured soldiers who manage to negotiate their way out of the military’s medical system and into Kessler. After only a few minutes spent in non-stop conversation with this renegade in a small patient examining room in West Orange, it’s abundantly clear that soldiers like Army Sergeant Daniel Tallouzi — just one of the most recent military patients under his care — are lucky to have
"UNFORTUNATELY, BECAUSE OF THE WAR, WE ARE RIDING A TREMENDOUS WAVE OF KNOWLEDGE IN THIS FIELD. I LIKE TO THINK OF MYSELF AS A MAD SCIENTIST WHO TINKERS AND EXPERIMENTS, BUT IF YOU AREN'T CREATIVE AND GUTSY, THEN YOU DON'T BELONG IN BRAIN INJURY REHABILITATION."

damage. And, the fourth mechanism causing brain injury, as well as all the other poly-traumatic, “dirty” wounds, comes from the falling debris. Troops end up with burns, fractures, and crushed limbs, all of which may trigger systemic effects. Explosion related side effects include everything from the TBI Fellus treats to amputation, fractures, lacerations, psychological disturbances (PTSD), crush injuries, impaired hearing and balance, blindness, impaired speech, renal damage, pulmonary damage, cardiovascular complications (shock), other organ damage, pain and neuropathies.

Meanwhile, clinicians who work at the Department of Defense (DOD) and the Veterans’ Affairs (VA) Administration have presented formally at scientific meetings that these war injuries may be unprecedented. As David Tulsky, PhD, NJMS associate professor, Vice President of Outcomes Assessment Research and the Director of Spinal Cord Injury at the Kessler Medical Rehabilitation Research and Education Center (KMRREC), admits, “I’ve heard people within the VA system ask, ‘Could these be totally new injuries?’ They certainly aren’t the same as what clinicians like Dr. Fellus treats as a result of car or motor vehicle accidents. I suspect that the VA and DOD have never had so many injured so quickly and so severely with amputations, spinal cord trauma and brain injury.”

Not a neurosurgeon, Fellus likes to think of himself as performing surgery with his own brain using his ability to envision the neuro-chemical, psychological and pharmacological scene inside a soldier’s head. “This is the most rewarding thing that I could be doing,” he insists. But it takes willingness to go through a lot of trial and error. “I come to work believing that I am going to hit a home run every single day. There is no brain injury that looks exactly like the next one. Every one is new and different,” which may be why the uncharted territory of the neuro-psychopharmacology of the brain was an area that chose him. “I would hate having to follow a formulaic cookbook approach to an injury.” He prefers practicing medicine in a miasma of symptoms. “For better or for worse, my career, particular interests and talents are perfectly timed to this wave of war-related brain injuries.”

Fellus believes that clinicians can’t afford to wait until every medication or therapy has been vetted in clinical trials. Nor can they opt for prescribing just one or two drugs. That conservative approach can lose a patient a slim window of opportunity for healing in the brain, closed too often when soldiers are simply left in bed without adequate physical therapy and overmedicated on muscle relaxants and anti-seizure medications which actually slow down brain functions. “Time is
JONATHAN FELLUS, MD
ASSISTANT PROFESSOR, UMDNJ-NEW JERSEY MEDICAL SCHOOL
DIRECTOR OF BRAIN INJURY SERVICES AT KESSLER INSTITUTE OF REHABILITATION
a cruel mistress,” Fellus admits.

Here’s one of the first dramatically simple things he does for the injured soldiers who are arriving more and more often at Kessler:

“I wake them up during the day and put them to sleep at night,” he says.

Seriously, for patients like Sergeant Tallouzi, “the goal was to take away the medications that were getting in the way of brain function and blocking certain chemical systems, suppressing activity.” Two common anti-seizure medicines are routinely used in care elsewhere but they inhibit recovery, slow cognition, impair balance and have long-term side effects, according to Fellus. To stimulate these injured brains, “I beg, borrow and steal from medicines and knowledge in other neurological disorders, including Alzheimer’s and Parkinson’s.”

In his weaponry for this battle against brain injury, you’ll find a wide range of treatment options, from a pump to infuse muscle relaxants into the body without affecting brain activity, to median nerve stimulators for opening up the language area in the left hemisphere. “It’s my job to know everything, especially about medications, which ones are in the pipeline, how to use them creatively, and how to use their side effects to the patient’s advantage.” He is also constantly prowling the literature for “even an inkling of what might help.” Medications to stimulate the neurotransmitters in the brain are high on his list and Fellus relies on “meds like dopamine, acetylcholine, neuroadrenalin, and glutamate” for these patients.

Perhaps the most dramatic aspect of the Fellus approach to care is that patients are typically given not one or two clinically-trial tested, approved medications, but up to eight or ten pharmaceuticals at one time.

“Ten drugs at one time?”

“Well, yes…I throw everything I’ve got at them at first until I get consistent results.” But he takes a rational, cautious tack, watching closely for reactions, refining his approach and monitoring the responses as each medication takes effect. Using quantitative EEGs, which can measure and record electrical activity in the brain, he checks inside these injured brains regularly for changes and activity. “We can’t use functional MRI (fMRI) equipment because of the risk of embedded shrapnel or metal.” But portable EEGs used at bedside can provide an objective, neuro-physiological measure so we can track the brain waves moving from slow frequency toward normalization. This helps guide the pharmacological and clinical interventions. “Sometimes I’ll pull back on a drug that is turning out to be too much of a good thing in terms of over-stimulation.”

Along with these mixed drug cocktails, sound sleep at night, and long hours of intense daytime physical, speech and occupational therapy, hormones are high on his list.

“The disruption of the hormone systems in the brain is a hugely underappreciated area.” It’s well known that after a TBI, some people develop acne, some women stop menstruating and some patients feel unnaturally cold, all signals of hormonal dysfunction. The regulation by the pituitary gland has been damaged. Testosterone, for instance, is so important for mood, energy, musculoskeletal health and obviously sexual function and Fellus has picked up on low levels of this essential human ingredient in veterans there at Kessler. He measures and supplements when possible. Progesterone, he reports, has been shown conclusively to limit the trauma in animal models of TBI.

Elie Elovic, MD, Director of Traumatic Brain Injury Research at KMRREC, agrees. “Hormones are chemical neurotransmitters, active ingredients that affect a body’s function level. Too often, people
pooh-pooh this relationship between hormones and quality of life.” Elovic’s research team has already shown how a drop in insulin growth factor, a hormone they evaluated, is related to fatigue, less community integration and more depression.

“Theoretically, we know we can intervene now and make a difference.” The Kessler team believes strongly that victims of TBI should always be evaluated for endocrine dysfunction as a potential treatment that can otherwise be missed.

One component of what Fellus calls his “advanced treatment protocol” was developed in coordination with Phil DeFina, PhD, chief executive officer as well as chief scientific officer at the International Brain Research Foundation. This involves nutriceuticals, or nutrients, to support brain health. Mega-doses of Omega 3 fatty acid fish oil, curcumin or turmeric extract (the ingredient in curry which is being studied for Alzheimer’s), gingko biloba, B vitamins, and other elements are added to a therapeutic dietary regimen. “We know that part of the cascade of symptoms in the brain is caused by the inflammatory process so we need to modulate this.”

Eyebrows raise and more conservative physicians sometimes question Fellus’ aggressive tactics. But he’s lectured to audiences of military medical personnel who recognize the value of this approach. Jokingly, he calls critics “nattering nabobs of negativism or therapeutic nihilists.” At the end of the day, he wants his patients’ loved ones to say thank you for an accurate diagnosis and for “unleashing the best pharmacology, techniques and modes of stimulation known to medicine.” He admits, “Brain injury is a crapshoot. Guess what? Sometimes you have to pull out all the stops. These patients may have only one shot at rehabilitation. If I don’t use everything in my power that is rational, or may help based on my understanding of the mechanism of the injury and the clinical situation lying right before me, then I’d better step out of the way.” And spoken like a general determined to win victory, he says, “The key to TBI is a kaleidoscope of interventions to assault the injury from all sides. Look, some of the greatest breakthroughs in medicine have come from people who stumbled upon something luckily. How are you going to stumble on that something unless you try, observe and keep your mind open?”

Daniel Tallouzi, an injured helicopter electronics technician, has spent months at Kessler away from his home in New Mexico. He is certainly not the same young man who was wounded in Iraq, but his mother Mary applauds this open-minded approach to brain rehabilitation and can say with an easy heart, “No matter what happens, all you know is that you did your best.”

### The War Medicine Scandal

**INTERVIEW EXPERTS IN WAR-RELATED INJURIES AND EVEN THE TOUGHEST, COOL-HEADED DOCTOR IS LIKELY TO BE FRUSTRATED ABOUT THE CURRENT STATE OF CARING FOR SOLDIERS WOUNDED IN THE IRAQI OR AFGHANISTAN WAR ZONES. WE KNOW BETTER. WE KNOW MORE. WE HAVE STANDARDIZED MODELS OF CARE FOR THESE MULTIPLY-INJURED VETERANS THAT AREN’T BEING UTILIZED. WE HAVE DIAGNOSTIC TOOLS AND INFORMATION ABOUT PHARMACEUTICALS, HORMONES AND NUTRIENTS, WHICH ARE BEING IGNORED.**

Across the country, there are 14 specialized hospital network systems, centers of excellence, established by an act of Congress — UMDNJ-NJMS University Hospital / Kessler Institute of Rehabilitation are included on this list — which should be a first stop for answers to the war-related medical nightmares of not only traumatic brain injury but also spinal cord injury.

First established back in the 1970s, “these distinguished centers have learned how to treat people through patients who have come through the systems.” All 14 have been providing data to a national collection center so this longitudinal information is having a huge impact on knowledge of SCI and TBI. “With war comes great opportunity for medical advancement,” says Elie Elovic, MD, Director of Traumatic Brain Injury Research at Kessler Medical Rehabilitation Research and Education Center.

Yet, Elovic says, “A large number of state-of-the-art novel treatments intended for traumatic brain injury are not being tried” in the military at this time. John DeLuca, PhD, NJMS professor and Director of Neuroscience Research at KMRREC, points out that Near Infrared Spectroscopy (NIRS), for example, is an inexpensive imaging tool that could be used right in battle to determine whether or not a soldier had suffered even mild TBI. There would be no need to ship someone off to Germany for a functional MRI or to accuse an individual of faking to escape the stress of war. This portable tool offers a true working picture of the brain “so you don’t have to simply look at behavior or emotions. You can see the brain scan right there on the field so a commander could say, ‘Ok, we’re not sending you back in.’ We are working on NIRS right now,” DeLuca says. He’s also developed programs to improve mental processing in victims of TBI so that memory problems can be partially overcome. “If you were a Pentium computer before your TBI, sadly your brain is more like a 286 processor afterward,” he explains. In fact, memory, which is more than a single entity and involves learning, storing and retrieving information, is the number one complaint in mild TBI.

“We have techniques to help improve these functions,” DeLuca says, “really good studies to show they work. Are we applying them to soldiers and veterans?” The military is simply identifying the disorder and sending victims with this cognitive burden off with little help, according to DeLuca. “This brain injury becomes cumulative. You start failing at work and at home. Friends think something is wrong with you. You lose your job, your house, your family, your life. You get upset. You get depressed. It all accumulates.”

While Elovic admits that the Kessler team is testing and utilizing modalities that are more aggressive than standard treatments, he says, “I think we owe our soldiers who have put their lives on the line the most aggressive care. Frankly, that window for recovery can easily be 12 to 18 months and too often, aggressive treatment isn’t looked at until after this window has closed.” Emails asking for his advice come from all over the country. “I try to give people the