Medical Xpress

Scientists discover unique pattern of hidden brain damage in male soldiers exposed to high explosive blasts

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Scientists have identified a distinctive pattern of injury in the brains of eight deceased military personnel who survived high explosive attacks and died between 4 days and 9 years later from their injuries or other causes.

The findings published in *The Lancet Neurology* journal suggest that the pattern of damage to the brain seen among men exposed to blast shockwaves was different to the pattern of damage seen in men exposed to other types of head injury. However, the authors warn that the lack of information about the soldiers' medical histories means that more research is needed to better understand associations between brain damage and the development of neuropsychiatric symptoms reported by soldiers exposed to blast shockwaves from high explosives, such as grenades and mortars, and improvised explosive devices (IEDs).

"Blast-related brain injuries are the signature injury of modern military conflicts", explains senior author Dr Daniel Perl from the Uniformed Services University of the Health Sciences, Maryland, USA. "Although routine imaging for blast-related traumatic brain injury often shows no brain abnormalities, soldiers frequently report debilitating neuropsychiatric symptoms such as headaches, sleep disturbance, memory problems, erratic behaviour and depression suggesting structural damage to the brain. Because the underlying pathophysiology is unknown, we have difficulty diagnosing and treating these 'invisible wounds'."

With more than 300,000 US service personnel deployed to conflicts in Afghanistan and Iraq sustaining at least one traumatic brain injury (TBI) caused by exposure to explosive blasts (ranging from mild concussion to memory and cognition problems), the long-term consequences of hidden brain injuries from explosive devices are a growing concern. Yet, very little is known about the underlying neuropathology of TBI.

Dr Perl and colleagues examined the brain tissues of eight deceased former military personnel who survived explosive attacks in combat but later died of other causes. In five male soldiers who survived more than 6 months after blast exposure, they found a distinctive, consistent, and unique pattern of prominent scarring in parts of the brain that are crucial for cognitive function, memory, sleep and other important functions. In case one, for example, scarring was seen in several structures associated with post-traumatic stress disorder (PTSD).

The brains of three male soldiers who died shortly after an explosive blast (4-60 days) showed a similar distinctive pattern of early scar formation in the same locations, further suggesting that this unique pattern may relate to the blast itself.

The researchers compared the soldier's brains to those of 15 male civilians including individuals with histories of exposure to impact traumatic brain injury through contact sports and motor vehicle accidents. The authors also studied cases with chronic opioid abuse and a case with chronic traumatic encephalopathy (CTE; a neurodegenerative disorder related to repeated head trauma associated with participation in contact sports).

The study is a case series, meaning that the findings are descriptive and show differences between the brains of men exposed to blast injuries and those that weren't. With this methodology, it is not possible to discern whether the scars found in the brains of these soldiers were the direct consequence of the blast. As Dr Perl explains, "In these controls we did not see similar scarring to the blast cases, which increases the likelihood that the pattern is linked with high-explosive exposure. Although little is known about the effect of blast shockwave on the human brain, the unique pattern of damage that we found is consistent with known shockwave effects on the human body."

"This is one small study, with limitations", adds Dr Perl. "It is virtually impossible to obtain comprehensive head injury histories to rule out previous traumatic brain injury, or to get accurate data on injury severity such as the number of blast exposures, proximity to detonation, and power of explosion. As exposure to blast shockwaves increases among soldiers and civilians in war zones, we need to further study these patterns, and compare them with soldiers' medical history in order to build a better understanding of the neuropathology of traumatic brain injury."

Writing in a linked Comment, Dr William Stewart at the University of Glasgow, UK and Dr Douglas Smith at the University of Pennsylvania, Philadelphia, USA say that whether these findings stand up to scrutiny from more comprehensive studies remains to be seen. They write, "Unquestionably, [this study] is commendable in drawing attention to the need for careful study of human tissue to further understanding of traumatic brain injury. However, far from an answer to the question of what is blast traumatic brain injury, the work instead exposes the remarkable absence of robust human neuropathology studies in this field. Progress in TBI research, both blast and non-blast, can only benefit from efforts directed specifically to facilitate acquisition of human tissue samples linked to detailed clinical information to support robust and informative neuropathology studies. Meanwhile, we must remain cautious in interpreting the significance of any single pathology as unique to blast-associated TBI based on a small and heterogeneous case series and little clinical information, and few control comparisons."

More information: *The Lancet Neurology*, www.thelancet.com/journals/lan … (16)30057-6/abstract

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