

# **Blast overpressure is generated from the firing of weapons and may cause brain injury**

January 28 2009

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The brain may be injured by the noise, which is produced when, for example, an anti-tank weapon (Bazooka, Karl Gustav) or a howitzer (Haubits) is fired. Scientists at the Sahlgrenska Academy demonstrated mild injury to brain tissue. In response to this, the Swedish Armed Forces restricted the number of rounds per day Swedish personnel can be exposed to.

A number of reports, which have appeared during the last few years, have shown that the brain is sensitive to blast. This study determines whether the occupational standards for the highest levels of blast exposure were valid enough to avoid brain injuries. Traumatic brain injury is very common among war veterans from Iraq and Afghanistan and the majority has been exposed to explosions. The soldiers have symptoms of disorders of memory, mental processes, emotion, sleep, speech, vision and hearing. The symptoms may be similar to those of post traumatic stress syndrome, which may be caused by factors other than combat experience.

The Swedish Armed Forces sponsored a study, which has been carried out by scientists at the Sahlgrenska Academy, University of Gothenburg, Sweden. They have examined the effects of noise after the firing of a Haubits, an anti tank weapon (Karl Gustav) and an automatic rifle and by the detonation of plastic explosives underwater. The study was done on anaesthetized pigs and rats.

"We examined the maximal peak level of the blast in the brain

transmitted from the blast in the air, as well as, brain tissue changes that were detected with the microscope, says Annette Säljö, one of the scientists who conducted the study.

The noise produced by the firing of both the haubits and the anti-tank weapon exceeds the occupational standards for highest levels of blast exposure. The scientists found that the maximal peak levels of the blast were unexpectedly high in the brain, i.e. that skin and bone appeared to protect the brain poorly. The results suggest that the degree of transmission of a pressure wave from air or water to the brain depends on the dominating frequencies in the frequency spectrum of the noise; low frequencies are transmitted considerably better than high frequencies.

The microscopic examination of the brain showed that the blast from certain weapons produces small haemorrhages (bleeding) in the brain tissue and the meninges (lining of the brain). The examination also suggested that blast exposure leads to the development of brain edema, i.e. increased fluid content. The scientists were later able to support this finding with other measurements. The results are in agreement with findings in the brains of soldiers who had been injured or died after being exposed to explosions in wars, from WW1 to the war in Iraq.

In summary, the study shows that the maximal peak levels of blast generated by the firing of certain weapons led to a small but measurable effect on the brains of pigs and rats.

The study also showed that this effect on the brain becomes worse with increasing maximal peak blast levels. The results poses the question as to whether exposure to even lower levels of blast than previous thought injurious might be contributing to the large numbers of mild traumatic brain injuries in American military personnel.

"This is of course an occupational question for Swedish Armed Forces. In light of the results of the study, the Swedish military has instituted restrictions in the number of firing rounds a person is allowed to be exposed to in a single day", says Annette Säljö.

Direct studies on humans are difficult to perform, since biomarkers of injury in cerebrospinal fluid or blood and imaging studies such as computed tomography (CT) and magnetic resonance imaging (MRI) do not appear to be specific or sensitive enough to detect mild brain injury.

Source: University of Gothenburg

Citation: Blast overpressure is generated from the firing of weapons and may cause brain injury (2009, January 28) retrieved 29 December 2022 from <https://medicalxpress.com/news/2009-01-blast-overpressure-weapons-brain-injury.html>

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