TOWARD THE PREDICTION OF LUNG INJURY RISK CAUSED BY FRIEDLANDER BLAST WAVES

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To better protect soldiers from blast threat, it is necessary to quantify the variation in lung injury level resulting from the wearing of a thoracic protection. Given that current injury criteria are not adapted for this purpose, the objective is to propose an original approach to correlate a measurable parameter on a manikin with a pulmonary risk level. This tool will help in the evaluation of thoracic protective system, which are not all equal in terms of efficiency against the blast threat.

Lung injury data from large mammals from the literature are collected, allowing the definition of iso-impulse tolerance limits from no lung injury to extensive lung injuries (>60% of ecchymosis). Incident impulse is known to be one injury criterion for short-duration wave (<3 ms) but it does not permit the evaluation of protective system on a manikin. For that purpose, the iso-impulse tolerance limits were associated with the thoracic response of post-mortem swine under blast loading. It was found that the lung injury threshold in terms of incident impulse is 70 kPa.ms, corresponding to a chest wall peak of acceleration/velocity/displacement of 9,900 m/s², 4.4 m/s and 7.7 mm respectively. Lung injuries are considered as severe (30-60% of ecchymosis) when the incident impulse exceed 160 kPa.ms, leading to a chest wall peak of acceleration/velocity/displacement of 40.3 km/s², 10.1 m/s² and 19.4 mm respectively.

A new methodology is proposed to determine lung tolerance limits in terms of incident impulse, maximum of chest wall acceleration, velocity and displacement. These limits are valid for a 50 kg swine exposed side-on to the blast threat and against a wall.
This is the first time that global kinematic parameters related to swine thoracic response are linked to lung injury levels.