E88 Explosive Force During a Wheel Blowout Induces Death

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The goals of this presentation are to present the power of a tire explosion and the effects a tire explosion has on a body.

This presentation will impact the forensic science community by illustrating the destructive potential of a pneumatic tire toward a body during an explosion in a confined space.

Explosive force during a wheel blowout occurring close to people approaches 20% mortality rates. Wheel blowouts, destroying the tire and rim, can cause bodily harm or even death when individuals are close to the explosion. Tire blowout causes vary, but common cases are punctures from sharp objects and structure failures due to wear or temperature fluctuations. Ruptured tires have been reported to displace air at speeds up to 1,000km/h and are powerful enough to move and cause damage to a nearby individual. In addition, the shock wave that is created can produce sudden changes of overpressures from 6.89 to 10.34 bars (100 to 150lb/in^2); however, there is a mortality of 1% for overpressure near 50 bars (725lb/in^2). Explosions occurring during heavy braking or when the rim is substantially heated (direct soldering on the rim) can cause shock waves with overpressures near 70 bars (1,000lb/ in^2). This leads to higher mortality rates of up to 50%. In comparison, the explosion from an 81mm mortar shell causes a shock wave of overpressure around 0.5 bars (7.25lb/in^2).

Tire explosions can result in primary, secondary, and tertiary lesions that may additionally cause fractures and amputation. The distribution of lesions depends on the position of the victim at the time of the accident. A higher proportion of skull, upper torso, and limbs are the areas more commonly affected (20%-48%) than other regions of the body.

A 55-year-old man died due to injuries acquired during the explosion of an agricultural pneumatic tire in a confined area. The individual was propelled against fixed elements, as this tire is capable of causing a shockwave overpressure up to 70 bar (1,000 lb/in^2). The tertiary lesions produced at the time of the accident are detailed.

The location of cranial thoracic lesions is consistent with the literature for this type of accident and is distinguished by the presence of seven immediate lethal lesions, first and foremost decapitation and the externalization of brain material. Multiple amputations of the upper limbs, an opening of the rib cage with externalization of the left lung, and a tear in the heart and aorta as well as the pulmonary veins were also observed. Diaphyseal amputation of the upper limbs can be related to the primary lesions. Indeed, a blast primarily causes diaphyseal fractures of articular fractures; however, the cranioencephalic trauma was attributed to tertiary lesions, which resulted in brain material deposited on the staircase behind the victim. The severity of this type of tertiary lesion is unreported in the literature.

Proximity to the explosion is proportional with more lesions and higher damage to the body. The victim's proximity to the explosion was extremely close, as observed from the welding marks, and the proximity caused serious bodily damage and dilapidation from the blast energy. Moreover, the explosion in a closed space accentuates different lesion

features due to the blast reflecting waves against a solid surface. Mortality rates are higher (77 against 8%, $p<0.001$) when an explosion occurs in a confined space. Here, the accident occurred in a hangar with walls less than five meters away from the body. Shock waves reflecting against the solid structures heightened the lethal character of the explosion.

In this accident, multiple factors led to the individual's death. The explosion, and not the bursting of the pneumatic tire, occurred in a confined space in close contact with the victim, thus not allowing the energy (overpressure) of the accident to dissipate into an open area. The gravity of the tertiary lesions was not the goal of our study, but rather to present an evaluation of the destructive potential at a short distance of the energy released during an explosion from a pneumatic tire in a finite space.

Tire, Blast, Injuries