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CASE REPORT ON ACCIDENTAL BLAST INJURY

Forensic Medicine

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ABSTRACT

A blast injury is a complex type of mechanical trauma resulting from direct or indirect exposure to an explosion. Blast injuries are generally seen in war conditions and terrorist attacks but rarely seen in non-military population. The interpretation of blast injuries carry great importance in understanding the patho-mechanism of these injuries which also helps in the management and investigation of blast incidence. In this report, we present a case in which an young labourer, became the victim of bomb explosion in his own vehicle. All the peculiarities and typical features of blast injuries were present at autopsy and an effort was made to correlate the autopsy findings with the circumstances of the case.

KEYWORDS

Blast, Injury, Autopsy, Marshall, Bomb.

INTRODUCTION

An Explosive is a substance that causes a sudden gas expansion, releasing potential energy capable of creating a pressure wave. Compression of air in front of the pressure wave may heat and accelerates air molecules leading to a sudden increase in atmospheric pressure and temperature. This may be transmitted to the surrounding environment as a radially propagating shock wave known as the blast wave. The blast wave as a result may produce three type of injuries. Injuries directly inflicted by sudden increase in air pressure may affect primary gas-containing structures (lungs, middle ear, and gastro-intestinal tract) and they are referred to as primary blast injuries, Secondary blast injuries result from fragments from explosive material and other displaced objects leading to penetrating trauma. When the body is accelerated away from the blast wave and lateral abruptly decelerated on rigid objects it may result in blunt force trauma and are called Tertiary blast injuries. Our country has limited experience in this field. Medico-legal autopsies examine both the injuries of those who died immediately as well as of survivors who died a short time later and it is important to categorize these deaths in order to verify the cause of death, observe the related injuries, create the blast scenario, when possible. This helps in establishing the cause of death and its relationship with blast event. The investigation of explosion-related fatalities can be a substantial challenge in medico-legal casework[13].

Case Report

On 30 May 2021, a 25yrs old man with history of explosive blast injury was brought to casualty, tertiary care centre, Nagpur and declared as brought dead. After the police investigation it was revealed that the young man is a worker in nearby quarry. He was carrying explosive material in his tractor which then suddenly exploded. The explosive material was suspected to be Gelatin sticks.

Autopsy findings:

External examination: After noting the weight (75kg) and height(176cm) of the body the external examination started with clothes which revealed blood and blackish stains and were teared at places. Upon external examination of body, superficial burns were found predominantly on anterior aspect of head, neck, chest, hands and lower limbs. Blackening of skin with tattooing present over body at places in the exposed areas suggesting that the clothing was having a protective effect. Face shows multiple punctate lacerated wounds with surrounding skin showing blackening, tattooing and hair singeing (Marshal triad) fig:1. Complete disruption of tissues of left hand along with Traumatic amputation of right lower limb was present below the knee joint suggesting that the distance between explosive material and the lower limbs of the deceased person was less compared to other parts of body. fig.2 and 3.

Internal examination: The body cavities were opened in routine manner. Starting with the head, which revealed under-scalp hematoma over right and left frontal region. Undisplaced fracture of right orbital plate (part of anterior cranial fossa) present. Sub arachnoid hemorrhage present over right frontal region as a thin film. The internal examination of the trunk revealed no fractures of the ribs, sternum, or vertebral column. Both right and lungs were collapsed and subpleural space was hemorrhagic. Internal examination over abdomen revealed no associated trauma.

Histopathological examination:

The microscopic examination of the lungs revealed enlargement of the alveolar spaces, rupture and thinning of the alveolar septae, interstitial perivascular haemorrhages, showing a cuff-like pattern around the pulmonary vessels. All these findings suggest features of blast lung.fig.4

Samples preserved and results:

1. Toxicology- Routine Viscera- toxicological analysis was negative.
2. For Ballistics- clothes, skin swab and skin, foreign material over body. Chemical analysis revealed Gelginite.

DISCUSSION

Explosives are those materials that gets rapidly converted into gases when detonated.

Primary injury is caused by the blast wave itself which results in sudden increase in air pressure after an explosion. Primary Blast injuries are mediated by different mechanisms; primarily 1) spallation, 2) implosion and 3) inertial effects

Secondary injury is caused by the fragments of casing, glass, etc, propelled by the explosion.

Tertiary injury is caused by the acceleration of whole or part of the body by the blast wind resulting from the explosion. Apart from movement of the body, this will result in traumatic amputation of an exposed limb should the remainder of the body be protected from the full force of the blast wind.

Fig.1: Marshal triad: Punctate bruises, laceration and abrasions

Fig.2: Traumatic amputation of right leg

Fig.3: Partial amputation of left hand

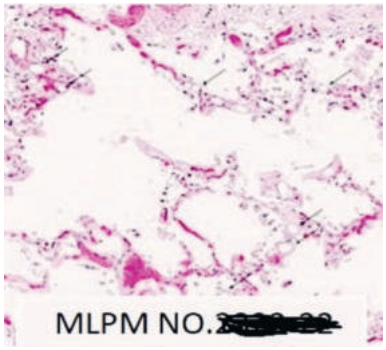

Fig.4: Histopathology of blast lung

Table: Blast injuries of different categories matched with current case[2]

Category	Injury caused by	Primary target organ	Autopsy match with current case
Primary blast injury	Blast wave	Ears, lungs, GI tract, CNS	Blast lung.
Secondary blast injury	Victim struck by flying debris	Skin, CNS, eyes, musculoskeletal system	Marshal triad in face.
Tertiary blast injury	Acceleration + Impact with stationary objects.	Abdominal viscera, CNS, lungs, skin, musculoskeletal system	Traumatic amputation of leg and hand
Miscellaneous	Inhalation of dust, toxic gases, burns, radiation, psychological impact	Lungs, skin, musculoskeletal system	Tattooing and singeing of hair.

Table.1 Effect of a blast wave in open spaces as compared with closed spaces[13]

Blast wave effect	Location	
	Open spaces	Closed spaces
Mortality	Low	High
Multiple injury	Low	High
Blast lung injury	Low	High
Wounding potential	Low	High

Sequence of events in a Blast Lung:

1. Pressure wave causes chest wall displacement towards the spinal column, leading to a transient high intrathoracic pressure.
2. Stripping of the airway epithelium,
3. Tearing of the alveolar septae,
4. Rupture of the alveolar spaces with consequent alveolar haemorrhage, oedema, and alveolar-venous fistulae.

Posture during the time of blast event:

Based on the injuries and circumstances provided, it is possible to interpret the posture of the victim during the time of blast event. In the present case injuries sustained as a result of explosion is maximum in the right leg, left hand upper aspect of chest and face (decreasing order). Suggesting that they were in close proximity to the blast radius. Also injuries over antero inferior aspect were more in number and severity comparatively to the postero superior aspect. Taking the circumstantial evidence and various injuries into consideration the deceased person must have been in (driver position)-Sitting position with leaning forward and face facing straight/down with explosive material lying close to the leg (Rt).

CONCLUSIONS

The post-mortem examination is critical to the investigation of any deaths and it is has to be even more meticulously done in explosives-related deaths. In our autopsy-based study, we found a significant blast lung injury without co-existing blunt or penetrating chest trauma, along with histopathology findings suggesting a blast lung. Physicians and surgeons should have a better interpretation of patho-mechanism of explosion injuries so that it aids in investigation and management. In conclusion, we present this autopsy-based investigation to provide further insight into blast injuries, which are rare events[13].

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