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Case report

Fatal accident due to anti-personnel ARGES EM01 rifle grenade explosion

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ABSTRACT

During the process of unsealing an old ammunition box in order to destroy it, a 42-year-old ammunition technician was fatally injured due to an anti-personnel ARGES EM01-type rifle grenade detonation. The explosion took place in the victim's hands, in point-blank range. This report aimed to show the anatomical position, the severity and the dispersion extent of the multiple injuries in the human body due to the detonation, and draw firm conclusions regarding the position of the human body and the circumstances prevailing at the moment of the explosion.

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Introduction

In the standard procedure, boxes of ammunition from the military reserve whose date of safe use has expired should be opened for inspection and subsequently final destroy.

During a scheduled job of unsealing and destroying an ARGES EM01-type grenade box, a 42-year-old man, who was a military officer in charge of bomb disposal, accidentally died from the unexpected detonation. He was evacuated to the military hospital where his death was declared.

Case report

Rifle grenade detonation

The conversion of a defense grenade (hand grenade) into a rifle grenade is done with the installation of a specific component. The rifle grenade ARGES EM01 weighs 355 g and consists of the launcher and the defensive grenade (hand grenade) ARGES 73 (Fig. 1).

It has an oval shape surrounded by a plastic shell. On the inner surface, there are approximately 2600 steel balls with a diameter of 2.5 mm each, which contain the explosive matter (plasticized pentaerythritol tetranitrate, PETN) and are responsible for causing severe bodily injuries. The anti-personnel ARGES EM01–type rifle grenade is a hand grenade which is converted into a rifle grenade in order to increase the grenade range in comparison to the average hand grenade whose throwing distance is 45 m. The installation of the rifle grenade results in the shot distance of up to 250 m. The radius of the entire dispersion and therefore the lethal range are 18–20 m. The ballistics performance is measured by the number of actual perforations caused on 20 mm-thick boards. The boards are arranged as parts of a circumference with a radius of 2, 3, 5, 10, 15 and 20 m from the source of explosion, which is 1 m above the soil surface. Rifle grenades are packed in a wooden box. Every wooden box contains 30 grenades and each grenade is kept in a special plastic case.[1,2]

The shock wave progresses from the epicenter of donation and spreads as a sphere of compressed and rapidly expanding gases, which displaces an equal volume of air at a very high velocity. A hurricane-force wind (approximately 200 km/h) exerts 1.72 kPa overpressure in comparison to a lethal blast-induced overpressure of 690 kPa, which travels at a velocity of approximately 2414 km/h. The magnitude of the damage due to the blast wave is dependent on the peak of the initial positive pressure wave (an overpressure of 414–552 kPa is considered potentially lethal), the duration of the overpressure, the medium in which it explodes, the distance from the incident blast wave and the degree of focusing due to a confined area or walls.[3]

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Fig. 1. ARGES 73-type rifle grenade.

Clinical management

The victim was evacuated by a military vehicle to the nearest hospital immediately after the explosion of the rifle grenade. The absence of medical or nursing staff in the field as well as the multiple diffuse injuries throughout his body created confusion among the soldiers who were present. The evacuation of the injured to the hospital was rapid, but without any first aid services.

The victim deceased on the operation table, 15–20 min after the explosion of the rifle grenade. By the time of the patient's death, only two surgical-exploratory incisions had been made in the anterior thoracic region for the determination of the extent of the bleeding and its further cessation (Fig. 2).

The multiple, dispersedly distributed injuries and the concomitant bleeding caused massive blood loss, which resulted in the hemodynamic instability of the patient. He was in good nutrition and had no other known medical history.

Forensic examination – autopsy findings

The forensic examination revealed that there were multiple injuries in his body, distributed in the anterior surface of the torso, as well as the extremities, and the maxillofacial burn injury was also identified.

The majority of wounds were found to be of ring-shape and with the evidence of hyperthermal damage. Unevenly shaped ecchymotic lesions were also observed along with concomitant purpura and intense redness of the anatomical areas surrounding the wound.

The injuries were detected mainly in the facial area, on the right upper abdomen, on the left lower abdomen and in the left femoral area. The multiple injuries on the face and forehead (frontal area) caused even partial deformation of the facial features (wounds on lower and upper lips of the mouth, around and within the eyes). The lesions ranged from the forehead to the feet (Fig. 2).

In the finger and palmar area of right upper limb, injuries with partial soft tissue deficit were found to carry the evidence of burn damage (Fig. 3). The left arm was amputated at the height of medial palmar area. On the wound edges at the site of amputation, the evidences of skin lacerations and burn injuries were observed (Fig. 4).

During the dissection of the body cavities in the autopsy, multiple ruptures were recorded in the lungs, heart and abdominal organs (Fig. 5). Cerebral hemorrhage was also detected (Fig. 6). Death occurred due to post-hemorrhagic shock as a consequence of multiple injuries caused by the rifle grenade detonation.

Discussion

The injuries in the human body are closely related to the distance from the epicenter, the body gesture at the time of donation, the type of the explosive device and the clothing thickness of the victim. Greater distance from the explosion epicenter results in less severe injuries in the body. Shorter distance from the epicenter causes more extensive damage to the body. If the distance was too short, there should be extremely severe wounds, even the dislocation of the body.[4–14]

Fig. 2. Dispersion of traumatic lesions on the human body.

Fig. 3. Wounds of the right hand.

Fig. 4. Wounds of the left hand (holding the grenade).

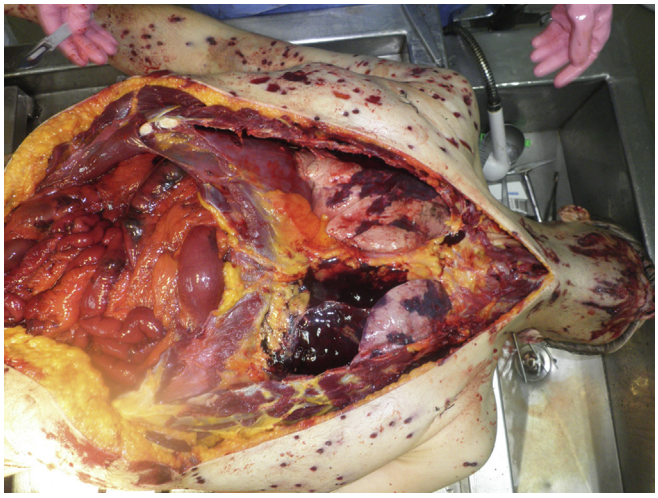

Fig. 5. Severity of injuries in the human body (chest cavity). Ruptures and exsanguinated pulmonary regions were observed, which was typical of great blood loss.

Fig. 6. Severity of injuries caused by explosion shock wave (overpressure).

The unexpected detonation of an explosive device may be caused either by the instability of the explosive ingredients or by mishandling. Aged ammunition may become unstable and therefore be dangerous under specific circumstances.

The explosive substance of ARGES 73 rifle grenades (pentaerythritol tetranitrate) is inactive in percussion or dropping and it is rare to cause detonation in that way. The behavior of the explosive substance is also relatively safe in long-term storage. A cause of grenade instability is the grenade fuse, which, under normal conditions, is stable, but after long-term storage some parts may become unstable.[2]

The examination of the victim's clothing in order to detect any possible burns as well as the injuries detected on the body of the deceased provided reliable information about the distance of the grenade detonation and the position of the victim at the time of the explosion.

The magnitude and spread of projectiles on the human body in this case provided reliable data about the position of the victim and the way that he was holding the rifle grenade. The explosion that occurred at point-blank range in relation to the distribution area of wounds leads to the conclusion that the deceased was holding the rifle grenade in his left hand and was in a kneeling position. The dilapidated state of the explosive device resulted in the weakening of the blast overpressure wave, causing death mainly due to injuries induced by fragmentation.

The lethal effect of the explosion always raises the question of the conditions prevailing at the moment of detonation as well as any responsibilities that may possibly exist for the causes of the accident. A thorough investigation of the injuries' anatomical position, depth and direction in the human body is essential to conclude the manner and the cause of the accident occurrence.

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