CASE REPORT

REACTOR EXPLOSION – BLAST INJURIES IN PHARMACEUTICAL FACTORY: A CASE REPORT

Yandra Pydiraju[1], Kusuma Jeevan Pradeep[2], Pedada Venkata Ramana Rao[3]

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ABSTRACT: Explosion is a sudden release of previously confined energy characterized by release of large volume of gas with high pressure, heat and noise. Explosion may be from two sources, improvised explosion devices or fuel-air explosion. Four workers were working at a chemical reactor in a pharmaceutical factory. On 5th January, 2013 explosion of chemical reactor took place in pharmaceutical factory at Nakkapalli, two succumbed to blast injuries on spot and two other succumbed to burns in hospital. Explosive forces are directional and decline rapidly.
KEYWORDS: Explosion, reactor, fuel-air explosion, blast injuries.

INTRODUCTION: Accidental civil tragedies occur in industries. India is a growing nation with industrialization. Improper handling and not maintaining machinery with knowledge and no constant supervision can cause disastrous effects and death. Here are case reports of four workers who succumbed to blast injuries at a chemical reactor explosion site while cleaning the reactor chamber.

CASE REPORT:

1. A male aged about 35 years received irregular lacerations disruptive injuries on the face, head, chest, abdomen with burns on both the lower limbs. Complete disfigurement of the face, head, mutilation of the chest, abdomen were noted with black sooty deposits on front of the injured areas. The noted burns in lower limbs are flash and flame burns, uniform and dermo-epidermal in nature. Flash burns were characterized by dry, reddish brown and parchment like small punctured wounds present on front aspect of mutilated body parts.
2. A male aged about 32 years with decapitation of the head at base of skull without any injury to the neck vertebrae by through and through irregular laceration surrounded by 1-2 cm abrasion. There was traumatic separation of both upper limbs at shoulder regions by irregular lacerations with black soot deposition at front of the both shoulders. An irregular peritoneal cavity deep lacerations on front lower abdomen exposing the lacerated and contused loops of intestines to the exterior. Multiple fragmentary fractures of pelvic bones with laceration genitalia were present. There was traumatic separation of right foot at lower 1/3rd leg. The above noted injuries were soiled with black soot stains and uniform dermo-epidermal burns were present all over body. Singeing of hair and line of redness were present. These traumatically separated parts were approximating with each other anatomically without re-duplication.

3. Infected dermo-epidermal burns of about 90-95% of the total body surface area were present on remaining two deceased with flame burns on the face, neck and flash burns on remaining parts of bodies.

DISCUSSION: The physics of explosions and blast waves are complex and nonlinear. Understanding some of the basic principles can provide pathologists with insight into possible injuries sustained from explosive events and lead to more accurate diagnosis and improved outcomes.[1] The chemical reactor in pharmaceutical factory was made up of iron and steel with a big chamber and the chamber was having lids and vents using for drug manufacturing. Individuals near walls are potentially subjected to exponentially increased over pressurization by wave reflection and those in corner areas of buildings even more so.[2]

At the time of cleaning the chamber, methanol was sent to the chamber of chemical reactor and high pressure was produced in the chamber. The pressure was released at regular intervals by unlocking the vents. On this certain day, the person who unlocks the vents left for breakfast without informing. Here the workers unknown of the facts about cleaning the chambers without opening the vents were succumbed to explosion. Hence they received blast injuries.

The blast consists of wave of compression called blast wave, spreads from the blast concentrically and the velocity gradually decreases as it spreads in particular direction. Normal explosion will produce gas with high pressure upto 1000 tons/square inch and generate temperature of gases upto 3000˚C. Minimum pressure of 100lb/square inch is necessary for tissue damage.[3] A person can be injured primarily, secondarily and tertiarily.[4] Primary blast injuries are those caused by barotrauma from the overpressurization blast wave. Secondary blast injuries result from penetrating or blunt trauma by projectiles hurled as a consequence of blast waves or blast wind. Tertiary blast injuries result from forceful displacement of the body by the blast wind and any resulting impact against obstacles. Quaternary injuries are those injuries related to explosions, but not caused by primary, secondary, or tertiary mechanisms.[4]

A high pressure can cause disruptive injury near the seat of explosion by blowing into pieces and scattering of pieces through a large area by force of explosion. If near enough to the skin to be contact with explosion, they can sustain a flame burns caused by contact with ignited clothing or at a greater distance the momentary heat radiation can cause flash burns. Fragmentary pieces of explosion and nearby solid structures act as flying missiles can cause penetration injuries, lacerations, abrasions and contusions along with debris cause tattooing. Injuries at distant persons from the blast can be caused by impacting of solid objects or trapped in collapsed building. Injuries resulting from structural collapse and fallen debris, such as crush injuries and compartment syndrome, are also examples of quaternary injury.[5] Up to 94% of those with primary blast injuries will have a ruptured tympanic membrane.[6]

In present case disruptive injuries and mutilation of the body and radiant flash burns and flame burns and black soot stains on the front of the body indicates that the two deceased were near the chemical reactor and in which the deceased 1 is standing at the edge of the chemical reactor bending forward receiving disruptive injuries above the pelvic region with complete mutilation on upper part of body and another (2nd deceased) was working one meter away from the reactor and received a decapitation injury by flying missile which was the cap of chamber.

The other two deceased who succumbed to burns were working two meters away from the chemical reactor.

Usually there is lack of evidence in cases of explosion hence it is difficult for a medico legal expert to opine on causation of injuries. The presence of explosive residue, initiator or accelerator at the scene of occurrence helps in investigation. Relevant autopsy findings and injuries: type, severity, distribution and evidence at the scene of blast need to be correlated in a scientific way.

The objects of post mortem examination in explosive injuries and deaths are:[7]

1. Identification of the deceased.
2. Documentation of injuries.
3. Collection of evidence.
4. Rule out ante or post mortem injuries.
5. Identification of natural disease.
6. Establishing cause, manner and time since death.

During post mortem examination, nonhuman tissues are identified and discarded by naked eye examination or antigen-antibody reaction test. Pieces of scalp, skin, jaw according to color, length and texture and pieces of skin separated according to colour. Joints are identified right or left along with hands and feet by size, configuration, skin color and texture.

Visceral organs like uterus, prostate, external genitalia help in fixing the sex and number of deceased. Clothing of the victim, fingerprint, dentition, dentures, scars, deformities, x-ray showing old fractures, stones, and bony deformities helps in identification.

CONCLUSION: From above post mortem examinations of the four deceased, the explosive forces are directional and decline rapidly and can cause flame burns and flash burns with stippling injuries on the body, the persons near the blast are blown into pieces and can be identified easily. The reactor chamber should be handled with utmost care and caution and timely supervision. Employers are legally required to assess the risk at work place and take all reasonable and practicable precautions to ensure safety of workers and the public.

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Figure 1

Figure 2

Figure 3

Figure 4

AUTHORS:

1. Yandra Pydiraju
2. Kusuma Jeevan Pradeep
3. Pedada Venkata Ramana Rao

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Forensic Medicine & Toxicology, Andhra Medical College, Visakhapatnam.
2. Associate Professor, Department of ENT, Andhra Medical College, Visakhapatnam.
3. Assistant Professor, Department of Forensic Medicine & Toxicology, Andhra Medical College, Visakhapatnam.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Yandra Pydiraju,
Assistant Professor,
Department of Forensic Medicine & Toxicology,
Andhra Medical College,
Visakhapatnam-530002.
E-mail: yandra.pydiraju@gmail.com

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