

# **Bomb and Blast Injuries**

## **Classification of Explosive:**

- High Order Explosive (HOE) – TNT, C-4, Semtex, Nitroglycerin, Dynamite, and Ammonium Nitrate Causes a supersonic over-pressurization shock wave.
- Low Order Explosive (LOE)– Pipe Bombs, Gunpowder, and most pure Petroleum-based bombs (i.e. Molotov cocktail). Causes subsonic explosion and lacks over-pressurization wave.
- Improvised Explosive Devices (IED) may be any combination of above

## **Mechanisms of Blast Injury:**

- Primary – Unique to HOE. From impact of over-pressurization wave with body surfaces. Gas filled structures such as lungs, GI tract, and middle ear are most susceptible. Leads to “Blast Lung” (pulmonary barotrauma), TM rupture, abdominal hemorrhage, globe rupture, concussion, air embolism.
- Secondary – From flying debris and bomb fragments. Any part of the body may be affected. Penetrating ballistic or blunt injuries. Eye penetration may be occult.
- Tertiary – From individuals being thrown by the blast wind. Any part of the body may be affected. Fracture and traumatic amputation as well as closed and open brain injuries may occur.
- Quaternary – Any explosion-related injuries, illnesses, or diseases not due to the other mechanisms, including exacerbation and complications of existing conditions, such as: burns, crush injuries, closed and open brain injury, asthma or COPD from breathing dust or smoke, angina, etc.

## **Common Blast Injuries:**

- Pulmonary Injury - “Blast Lung” is a consequence of the over-pressurization wave. Characterized by the clinical triad of apnea, bradycardia, and hypotension. Should be suspected in anyone with dyspnea, cough, hemoptysis, or chest pain following a blast. Produces a characteristic “butterfly” pattern on chest X-ray. Chest X-rays are recommended for all exposed patients. Prophylactic chest tubes are recommended before general anesthesia or air transport if blast lung is suspected. Very common in closed space explosions (i.e. bus, café).
- Ear Injury – TM perforation is the most common injury to the middle ear. Ear injury should be suspected in anyone presenting with hearing loss, tinnitus, otalgia, vertigo, bleeding from the external canal, or otorrhea. TM and ocular exam should be performed on ALL patients.
- Abdominal Injury – Primary blast effect can lead to immediate bowel perforation, hemorrhage, mesenteric shear injuries, solid organ lacerations, and testicular rupture. Consider blast abdominal injury in any exposed patient with abdominal pain, nausea, vomiting, hematemesis, rectal pain, tenesmus, testicular pain, unexplained hypovolemia, or acute abdomen.
- Brain Injury – In addition to more severe coup-contracoup brain injuries primary blast waves can cause concussions or mild traumatic brain injury without a direct blow to the head. Brain injury should be suspected with complaints of headache, fatigue, poor concentration, lethargy.

## **Emergency Management Tips:**

- Follow your hospital’s and regional disaster system’s plan if multiple casualties.
- Minor-appearing wounds may represent deeply penetrating shrapnel – extremely careful and thorough patient assessment required.
- Be aware that explosive materials or devices may be incorporated into wounds and pose danger to providers and that EOD consultation may be helpful if one encounters unusual foreign body material in a wound.
- Expect “upside-down” triage – the most severely injured arrive after the less injured, who bypass EMS triage and go to local hospitals for treatment.
- Double the first hour’s casualties for a rough prediction of the total expected number of acute casualties.
- Obtain information on nature of explosive, potential toxic exposures and environmental hazards.
- Screen patients as needed to rule out radiation (dirty bomb).
- Abdominal injuries can be clinically silent until acute abdomen or sepsis is advanced. Serial reexamination (every 4-6 hrs) of the abdomen and early surgical intervention may be needed.
- Compartment syndrome, crush injury, and rhabdomyolysis are associated with entrapment in collapsed structures, prolonged extrication, severe burns, and severe muscular injury from tertiary impact.
- Consider exposure to carbon monoxide, cyanide, or methemoglobin-forming toxins.

- Pulmonary blast injury can have delayed onset – patients with any injury from closed space blast exposure require 4-6 hours of observation.
- Confined spaces significantly increase injury and mortality.