UNIVERSAL BLAST INJURY SEVERITY

Blast Event

SCENE SAFETY
- Check in at staging area for safety briefing.
- Personal safety.
- PPE – Protective clothing, hard hats, eye protection, respiratory protection.
- Protection of uninjured public and volunteers.
- Protection of injured.
- Be aware of secondary explosive devices.
- Be aware of multi-agent devices, e.g. chemical release, dirty bomb, etc.

Triage Considerations
- Unique patterns, multiple and occult injuries.
- Deaths are often a result of combined blast, ballistic, and thermal effect injuries.
- Walking wounded and non-critical patients are time intensive.
- Hidden/internal injuries
- Overtriage can increase critical mortality – receiving from poor patient distribution from scene and self-referrals to hospitals.
- Up to 75% of victims will self-ref to hospital.
- Do patients require decontamination?

Initial triage, trauma resuscitation, and transport should follow standard protocols for multiple injured patients or mass casualties.

Factors that Contribute to Blast Injury Severity
- Was the Bombing In An Open Or Closed Space?
  • Low-order Explosive
  • High-order Explosive

Primary Injuries
- Unique to high-order explosive, results from the impact of the over-pressurization wave with body surfaces by the blast wave.

Head Injuries
- May or may not include history of loss of consciousness.
- Headache, seizures, dizziness, memory problems.
- Cerebral edema, brain edema, difficulty concentrating.
- Visual disturbances, tinnitus, blurred speech.
- Confusion, irritability, confusion.
- Extremity weakness or numbness.

Tympanic Membrane – Ear Injuries
- Treatment follows established protocols.
- Impaired hearing may complicate triage process.
- Secondary evaluation and examination to identify all blast-related injuries including perforated tympanic membranes.
- Sarcastic blast injuries; in the absence of it, presumed it.
- Stabilized patients without signs of significant blast injury, may be delayed and transferred to tertiary care or to the hospital.
- Patients should have urgent consultation and follow-up care with ENT specialist.
- Spontaneous hearing occurs in 50-80% of all patients with perforations.

Abdominal Injuries
- Treatment follows established protocols.
- Perforations can be delayed and develop 24 to 48 hours post blast.
- Treatment and symptoms can occur hours days after a blast.
- There is the possibility of missed injury, especially in semiconscious or unconscious patients.

Treatment follows established protocols, but it is important to remember that these injuries may be easily missed.

Blast Lung – Go to Blast Lung Injury Section

Secondary Injuries
- Results from flying debris and bomb fragments causing superficial wounds.
- Common injuries include:
  - Head injuries
  - Skull fractures
  - Brain fractures

Tertiary Injuries
- Results from individuals being blown by the blast wind.
- Common injuries include:
  - Burns
  - Head injuries
  - Ear injuries

Quaternary Injuries
- All explosion-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms.
- Common injuries include:
  - Burns
  - Head injuries

Crush Injuries – Go to Crush Injury Section

Combined Injuries
- Assist turned victims on one injury.
- Monitor fluid replacement amounts when treating blast lung with another injury.
- Fluid resuscitation targeted to vital signs, to avoid hypervolemia, judicious fluid administration in maintaining perfusion without volume overload.
- Transfer to a facility with specific expertise in both trauma and burn management, or at least the trauma management.

Hospital
- Fluid resuscitation guided by urine output. Consider monitoring central venous pressure, and systemic vascular resistance when indicated.

Additional resources can be found at: www.acep.org/blastinjury or www.bt.cdc.gov/masscasualties/
**CRUSH INJURY**

**Blast Event**

**ENTRAPPED PATIENT TREATMENT**
- Field resuscitation below the explosion
- 110 mg dopamine
- Light Stabilization
- Minimize potential systemic effects of separation (Constricting)

**CRUSH SYNDROME OR COMPARTMENT SYNDROME SUSPECTED?**

**Areas commonly affected:**
- Lower extremities
- Pelvis
- General regions

**SIGNS AND PRESENTATION OF CRUSH SYNDROME**

- Pain, Paresthesia, Pallor, Pulsion, Progression of symptoms (P5P5P)

**Clinical concerns:**
- The systemic effects are due to rhabdomyolysis and reperfusion of hypoxic and damaged tissues.
- Reparative effect of local blood results in the systemic effects of crush injuries.
- Patients may appear well until extricated, and then subsequently decompensate.
- Skeletal muscle damage is greatest among patients.
- Cardiovascular instability due to massive fluid shift, catecholamine administration, and direct myocellular toxicity.

**SIGNS OF COMPARTMENT SYNDROME**

- Pulselessness
- Progression of symptoms (P5P5P)
- Pain, Pallor, Paresthesia, Paralysis

**CRUSH SYNDROME TREATMENT – PREHOSPITAL**

**CRUSH SYNDROME**
- Primary survey and initial stabilization (ABCD)
- Fluid resuscitation before patient is extricated with severe or prolonged entrapment of limb or pelvis

**COMPARTMENT SYNDROME**
- Primary survey and initial stabilization (ABCD)
- Suspect compartment syndrome due to mechanisms of injury, examination, and patient complaints.
- Treat other injuries
- If irreversible effects of crush injury, do not use contravening bandages or MAST trousers

**CRUSH SYNDROME TREATMENT – HOSPITAL**

**CRUSH SYNDROME**
- Fluid resuscitation
- Diagnose and treat other metabolic derangements
- Hypocalcemia

**COMPARTMENT SYNDROME**
- Primary survey, stabilization and resuscitation, secondary survey
- Diagnosis through examination and confirmation with compartment pressure measurements
- Treat systemic effects of compartment syndrome similar to crush injury

**Field Amputation**
- Best performed by an appropriately trained physician, such as a trauma or orthopedic surgeon
- Ensures adequate hemostasis and anesthesia

**BLAST LUNG INJURY**

**Blast Event**

**INITIAL TRIAGE, TRAUMA RESUSCITATION, AND TRANSPORT SHOULD FOLLOW STANDARD PROTOCOLS FOR MULTIPLE INJURED PATIENTS OR MASS CASUALTIES**

**Was the Bombing in an Open or Closed Space?**

- There is a higher incidence of blast lung injury in enclosed spaces

**SIGNS OR SYMPTOMS SUGGESTIVE OF BLI OR RESPIRATORY DISTRESS**

- Apnea, tachypnea, hypotension, hypoxia and cyanosis, cough, wheezing, dulness to percussion, decreased breath sounds, or hemoptysis

**SYMPTOMS**
- Dyspnea, hemoptysis, cough, chest pain

**CLINICAL CONCERNS**
- Blast lung, hemoptysis, pneumothorax, pulmonary contusion and hemorragage

**AIRWAY MANAGEMENT**

- Airway control
- Oxygen administration

**VITAL SIGNS AND OXYGEN**

- Vital Signs, Oxygen, EKG, IV

**PRECLINICAL AIRWAY MANAGEMENT**

- Additional treatment and transport

**MANAGEMENT**

- Oxygenation
- High flow O2, sufficient to prevent hypoxemia via non-rebreather mask, CPAP or endotracheal intubation.
- Hemostasis or Pneumothorax

**CLOSE OBSERVATION**

- Chest decompression for clinical presentation of tension pneumothorax
- Fluid administration
- Provide enough fluid to ensure tissue perfusion but avoid volume overload

**HOSPITAL DIAGNOSTIC EVALUATION**

- Chest radiography
- Arterial blood gases, computed tomography, and doppler ultrasound can be used to help diagnose BLI and an embolism
- Metastatic and diagnostic testing conducted per resuscitation protocols – based upon nature of explosion (e.g. confined space, fire, etc.)

**HOSPITAL DISPOSITION AND OUTCOME**

- No definitive guidelines for observation, admission, or discharge following emergency department evaluation for patients with possible BLI following an explosion.
- Patients diagnosed with BLI may require complex management and should be admitted to an intensive care unit. Patients with any complaints or findings suspicious for BLI should be observed in the hospital.
- Discharge decisions will also depend on associated injuries, other issues related to the event, including the patient’s current social situation.
- In general, patients with normal chest radiographs, blood gases, and pulse oximetry who have no complaints suggesting a BLI, can be considered for discharge after 4-6 hours of observation.
- Data on the short and long-term outcomes of patients with BLI is currently limited. However, in one study conducted on survivors one year post injury, no patients had pulmonary complications, all had normal physical examinations and chest radiographs, and most had normal pulmonary function tests.