Bombings: Injury Patterns and Care Pocket Guide

UNIVERSAL BLAST

ENVIRONMENT
- Blast Event

OTHER FACTORS
- Done: type - large (kitchen) or small (suitcase)
- Delivery method
- Distance from device
- Protective barriers

SCENE SAFETY
- Check in at staging area for safety briefing.
- Personal safety.
- PPE: protective clothing, hard hat, eye protective, respiratory protection.
- Protection of uninvolved 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
- Unusual patterns, multiple and occult injuries.
- Deaths is 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 - resulting from poor patient distribution from scene and self-referrals to hospitals.
- Up to 75% of victims 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

- What the Bombing Is An Open Or Closed Space? The effects of the blast wave are more intense in a confined space such as a building, bus or train.

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

- May or may not include history of loss of consciousness.
- Headache, nausea, dizziness, memory problems.
- Cold/fever problems, nausea/vomiting, difficulty concentrating.
- Visual disturbances, tinnitus, slowed speech.
- Disorientation, 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.
- Assess blast injuries can occur in the absence or presence of tympanic membrane rupture.
- Stable patients without signs and symptoms of significant blast injury, may be discharged after 4 to 6 hours of observation despite the presence of TM rupture.
- Patients should have urgent consultation and follow up care with ENT specialist.
- Spontaneous healing 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.
- Manifestations of peritonitis can occur hours in days after a blast.
- There is the possibility of missed injury, especially in ear traumatized or unconscious patients.

COMBINED INJURIES
- May or may not include history of loss of consciousness.
- Headache, nausea, dizziness, memory problems.
- Cold/fever problems, nausea/vomiting, difficulty concentrating.
- Visual disturbances, tinnitus, slowed speech.
- Disorientation, irritability, confusion.
- Extremity weakness or numbness.

SECONDARY INJURIES
Results from flying debris and bomb fragments causing superficial wounds.
- Common injuries include:
- Head injuries
- Soft tissue injuries

TERTIARY INJURIES
Results from individuals being thrown by the blast wind.
- Common injuries include:
- Head injuries
- Skull fractures
- Bone fractures

QUATERNARY INJURIES
All secondary-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms.
- Burns
- Head injuries
- Gastric injuries
- Complications of pre-existing medical conditions

CRUSH INJURIES – Go to Crush Injury Section

SECONDARY, TERTIARY, AND QUATERNARY INJURIES ARE COMMON IN BLAST EVENTS, AND LARGE MAJORITY ARE NOT CRITICAL.

IT IS UNLIKELY TO EXPERIENCE PATIENTS WITH INJURIES ISOLATED TO ONE CATEGORY. A MORE LIKELY SCENARIO WOULD BE TO EXPERIENCE PATIENTS WITH A COMBINATION OF ALL THE INJURIES LISTED BELOW.

TREATMENT FOR MOST OF THESE BLAST INJURIES FOLLOWS ESTABLISHED PROTOCOLS FOR THAT SPECIFIC INJURY.

Head Injuries
- Fluid resuscitation guided by urine output. Consider monitoring central venous pressure, and systemic vascular resistance when indicated.
**CRUSH INJURY**

**ENTRAPPED PATIENT TREATMENT**
- Fluid resuscitation following extrication
- 1 L NS bolus, 1-1.5 L/hr infusion
- Local Stabilization
- Minimize potential systemic effects of reperfusion (Messaupet)
- 1 ampule Sodium Bicarbonate (50 ml)
- or more reperfusion, followed by 1 ampule Sodium Bicarbonate with each liter of NS infused at 1-1.5 L/hr. Maintain sodium IV with Sodium Bicarbonate.

**FIELD AMPUTATION INDICATED? INDICATIONS?**
- Inability to safely extricate the patient
- Continued environmental toxins that pose a hazard to victims or rescuers
- When the extrication time would be long enough that it would endanger the patient’s life without field amputation

**CRUSH INJURY TREATMENT – HOSPITAL CRUSH SYNDROME**
- Primary survey and initial stabilization (ABCD)
- Fluid resuscitation before patient is extricated with severe or prolonged entrapment of limb or pelvis (more than a hand or foot).

**CRUSH SYNDROME**
- Primary survey and initial stabilization (ABCD)
- Suspect compartment syndrome due to mechanisms of injury, examination, and patient complaints.
- Treat other injuries
- Immobilized joint affected, do not use constricting bandages or MAST trousers

**CRUSH INJURY TREATMENT – HOSPITAL COMPARTMENT SYNDROME**
- Fluid resuscitation
- Diagnosis and treat other metabolic derangements
- Hypothermia
- Hypokalemia

**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 in orthopedic surgeon.
- Ensures allograft availability and anesthesia.

**IS CRUSH SYNDROME OR COMPARTMENT SYNDROME SUSPECTED?**
- Areas commonly affected:
  - Lower/lower extremities
  - Pelvis
  - Abdominal muscles

**SIGNS AND PRESENTATION OF CRUSH SYNDROME**
- Pain, Paresthesia, Paralysis, Pulselessness: Proportion of symptoms (or “6P”)

**Clinical concerns:**
- Pain: lasion with extravasation of blood or edema within a closed compartment.
- Paresthesia: Hyperesthesia, hyperesthesia, paresthesia.
- Pulselessness: Repetition of limb pain results in systemic effects of crush injuries.
- Patients may appear well until extricated, and then progressively decompensate.

**Body muscle damage is greatest after resuspension.**
- Cardiovascular instability due to massive fluid shift, cellular decompensation, and direct myocardial lysis.

---

**BLAST LUNG INJURY**

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

**What 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**
- Sputum, tachypnea, hypoxia, hypoxia and cyanosis, cough, wheezing, dyspnea, hemoptysis, oxygen saturation, chest wall motion.
- All had normal physical examination.

**SIGNS OR SYMPTOMS SUGGESTIVE OF BLI OR RESPIRATORY DISTRESS**
- Appropriate Treatment and Transport

**COMPLICATIONS**
- 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 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 complaints, all had normal physical examinations and chest radiographs, and most had normal pulmonary function tests.

---

**ENJOY THE LEAST CLOSER TO A CROSSWIND**
- Additional resources can be found at: www.acep.org/blastinjury or www.bt.cdc.gov/masscasualties/