**BOMBINGS: INJURY PATTERNS AND CARE POCKET GUIDE**

**SCENE SAFETY**

- Check in at staging area for safety briefing.
- Personnel safety.
- PPE – Protective clothing, hard hats, eye protection, 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 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 – resulting from fewer patient distribution from scene and self-referrals to hospitals.
- Up to 75% of victims self-report to hospital.
- Do patients require decontamination?

**Initial Triage, Triage Reassessment, and Transport** should follow standard protocols for multiple injured patients or mass casualties.

**Factors that Contribute to Blast Injury Severity**

- What was the Bombing in an Open or Closed Space?
  - The effects of the blast wave are more severe in a confined space such as a building, bus or train.

**Agent**

- Direct type – large vehicle or small suitcase
- Delivery method
- Distance from device
- Protective barriers

**Other Factors**

- Low-order Explosive
- High-order Explosive

**Factors that Contribute to Blast Injury Severity**

**UNIVERSAL BLAST EVENT**

- Blast wave
- Pressure wave
- Shock wave

**Primary Injuries**

- Unique to high-order explosions, 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, disorientation, memory problems
- Gait/balance problems, nausea/vomiting, difficulty concentrating.
- Visual disturbances, tinnitus, slowed speech.
- Obnolism, irritability, confusion.
- Extremity weakness or numbness.

**Tympanic Membrane – Ear Injuries**

- Perforations can be delayed and develop 24 to 48 hours post blast.
- Manifestations of perforation can occur hours or days after a blast.
- There is the possibility of raised ICP, especially in comatose 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 shrapnel wounds.
- Common injuries include:
  - Head injuries
  - Skull fractures
  - Bone fractures

**Tertiary Injuries**

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

**Quaternary Injuries**

- All explosion-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms.
- Common injuries include:
  - Burns
  - Head injuries
  - Exposure to pre-existing medical conditions

**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 to avoid fluid overload which can exacerbate blast lung injury.
- Airway management and ventilation: ventilation is critical and performed with standard techniques.

**Burn/Blast Injury**

- Burn injury will require significant amounts of fluid resuscitation while avoiding fluid overload to prevent further pulmonary injury.
- Fluid resuscitation targeted to vital signs, to avoid hyperviscosity, judicious fluid administration to maintain 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.

**Second, Tertiary, and Quaternary Injuries are Common in Blast Events, and Large Majorities 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.**

**Additional Resources**

- www.acep.org/blastinjury or www.bt.cdc.gov/masscasualties/

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ENTRAPPED PATIENT TREATMENT

- Fluid resuscitation before extraction
- 1-1.5 NS bolus, 1-1.5 L/hr infusion
- Limb Stabilization: Maintain potential systemic effects of reperfusion (myoglobin)

Field Amputation

- Indication to safely extricate the patient
- Continued environmental toxicant that pose a hazard to victims or rescuers
- When the extraction time would be long enough that it would endanger the patient’s life without field amputation

CRUSH INJURY TREATMENT – PREHOSPITAL

CRUSH SYNDROME

- Primary survey and initial stabilization (ABCD)
- Fluid resuscitation before extraction with severe or prolonged entrapment of limb or pelvis (more than a hand or foot)

COMPARTMENT SYNDROME

- Primary survey and initial stabilization (ABCD)
- Suspect compartment syndrome due to mechanisms of injury, examination, and patient complaints.
- Treat other injuries
- Immobile affected part: do not use restraining bandages or MAST trousers

CRUSH INJURY TREATMENT – HOSPITAL

SYNDROME

- Fluid resuscitation
- Diagnose and treat other metabolic derangements
- Hypervolemia
- Hyperkalemia

COMPARTMENT SYNDROME

- Primary survey, stabilization and resuscitation, secondary survey
- Diagnosis through examination and confirmation with compartment pressure measurement
- 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 adequate analgesia and anesthesia.

SIGNS OR SYMPTOMS SUGGESTIVE OF BLI OR RESPIRATORY DISTRESS

- Apnea, tachypnea, hypoxia, hypoxia and cyanosis, cough, wheezing, tachycardia to tachycardia, decreased breath sounds, or hemoptysis

SYMPTOMS – Dyspnea, hemoptysis, cough, and chest pain

CLINICAL CONCERNS – Blast lung, hemorrhage, pneumothorax, pulmonary contusion and hemorraghe, A-F waves (source of an embolism), penetrating chest trauma, and bilateral chest trauma. Evaluate patient for >10% BSA burns, shock, bacteremia, and penetrating trauma to head injuries

Airway Management Protocol

- If injury is open
- Antibiotics, tetanus, jet irrigation.
- Debridement of nonviable tissues.
- Early amputation for severely ischemic limbs may be required to reduce ischias.
- Fasciotomy.

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, bleb 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.

MANAGEMENT OXYGENATION

- High flow, sufficient to prevent hypoxemia via non-rebreather mask, CPAP, or endotracheal intubation.
- Hemoptysis 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.

AIR EMBOLISM

- Position in prone, semi-left lateral, or left lateral positions, transport to a facility with a hyperbaric chamber.
- "Close observation for any patient suspected of BLI for the development of tension pneumothorax transported by air.

HOSPITAL DIAGNOSTIC EVALUATION

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

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