Was The Bombing In An Open Or Closed Space?

BOMBINGS:
Injury Patterns and Care Pocket Guide

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

• Protective barriers
• Be aware of multi-agent devices, e.g. chemical release, dirty bomb, etc.

UNIVERSAL BLAST

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 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.

UNIVERSAL BLAST

Blast Event

FACTORS THAT CONTRIBUTE TO BLAST INJURY SEVERITY

ENVIRONMENT
• Is the bombing in 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.

AGENT
• Low-order Explosive
• High-order Explosive

OTHER FACTORS
• Distance type – large (overhead) or small (ground level)
• Delivery method
• Distance from device
• Protective barriers

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, nausea, dizziness, memory problems
• Gait/balance problems, nausea/vomiting, difficulty concentrating.
• Visual disturbances, tinnitus, slowed speech.
• Confusion, irritability, confusion
• Extremity weakness or numbness.

TYPANIC MEMBRANE – EAR INJURIES
• There is the possibility of missed injury, especially in semiconscious or unconscious.

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

SECONDARY INJURIES
Results from flying debris and bomb fragments causing superficial wounds.

TERTIARY INJURIES
Results from individuals being thrown by the blast wind.

QUATERNARY INJURIES
All combination-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms.

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 oxygenation/ventilation are critical and performed with standard techniques.

BURN/BLAST INJURY

PREHOSPITAL
• 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 hypotension; 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.

SECONDARY INJURY PATTERNS AND INJURY SEVERITY

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.

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TRIAGE CONSIDERATIONS
• Unanimous patterns; multiple and recoll 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 poor patient distribution from scene and self-referrals to hospitals.
• Up to 75% of victims self-report to hospital.
• Overtriage can increase critical mortality – resulting from poor patient distribution from scene and self-referrals to hospitals.
• True signs and symptoms of blast injury may not manifest for hours or days after a blast.
• A combination of primary, secondary, tertiary, and quaternary injuries.
• Immediate triage, trauma resuscitation, and transport should follow standard protocols for multiple injured patients or mass casualties.

ABDOMINAL INJURIES
• Spontaneous healing occurs in 50-80% of all patients with perforations.
• Patients should have urgent consultation and follow up care with ENT specialist.

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CRUSH INJURY

Blast Event

ENTRAPPED PATIENT TREATMENT

- Fluid resuscitation before extrication
- 110 NG bols, 1-1.5 L/hr infusion
- Link Stabilization
- Minimize potential systemic effects of reperfusion (tourniquets)

CRUSH INJURY TREATMENT – PREHOSPITAL

- Fluid resuscitation before extrication
- 1 ampule Sodium Bicarbonate (50 mEq) pre-extrication, followed by 1 ampule Sodium Bicarbonate with each 1 L NG infusion or 1-1.5 L/hr. Maintain a serum pH with Sodium Bicarbonate

FIELD AMPUTATION INDICATED?

INDICATIONS:

- Inability to safely extricate the patient
- Continued environmental stresses 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 SYNDROME OR COMPARTMENT SYNDROME SUSPECTED?

Areas commonly affected:
- Lower/Upper Extremities
- Pelvis
- Global regions
- Abdominal muscles

CRUSH INJURY TREATMENT – HOSPITAL

- Field resuscitation and fluid therapy
- Diagnose and treat other metabolic derangements
- Hypovolemia
- Hypoxemia

COMPARTMENT SYNDROME

- Primary survey and stabilization (ABCD)
- Fluid resuscitation before extrication with severe or prolonged entrapment of limb or pelvis (more than a hand or foot)
- Suspect compartment syndrome due to mechanisms of injury, examination, and patient complaints
- Treat other injuries
- Immobilize affected part; do not use constraining bandages or MAST brushes

SIGNS AND PRESENTATION OF CRUSH SYNDROME

- Pain, Paresthesia, Paralysis, Paresthesia, Paresthesia, Paresthesia
- Issues Incision and Prognosis of Incision (IPS)

Clinical concerns:

- The systemic effects are due to reperfusion and reperfusion of hypoxic and damaged tissues.
- Repetition of limb part results in the systemic effects of crush injuries.
- Patients may appear well until extrication, and then proprophyllically decompensate
- Global muscle damage is greatest after extrication
- Cardiovascular instability due to massive fluid shift, catecholamine, and direct myocardial toxicity

SIGNS OR SYMPTOMS SUGGESTIVE OF CRUSH INJURY OR RESPIRATORY DISTRESS

- Spacing – Apathe, tachypnea hypoventilation, hypoxia and cyanosis, cough, wheezing, dullness to percussion, decreased breath sounds, or hemoptysis

SYMPTOMS – Dyspnea, hypoxia, cough, and chest pain

CLINICAL CONCERNS – Blunt lung, hemothorax, pneumothorax, pulmonary contusion and hemorrhage, A-F waves (source of an embolism), penetrating chest trauma, and blunt chest trauma. Evaluate patient for >10% BSA burns, shaft fractures, and penetrating trauma or head injuries

CRUSH SYNDROME

- Fluid resuscitation
- Diagnose and treat other metabolic derangements
- Hypovolemia
- Hypoxemia

INFARCTION

- 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

SIGNS OF CRUSH SYNDROME

- Vitiligo, dryness, oxygen, EKG, IV – Additional treatment and transport

FIELD AMPUTATION

- Most performed by an appropriately trained physician, such as a trauma or orthopedic surgeon
- Ensures earlier extubation and anesthesia

CRUSH SYNDROME

- Vital signs, oxygen, EKG, IV – Additional treatment and transport

NO

YES

VITAL SIGNS, OXYGEN, MONITOR IV

Appropriate Treatment and Transport

Blast Event

INFERIOR TRACHEAL TRAUMA, RESUSCITATION, AND TRANSPORT SHOULD FOLLOW STANDARD PROTOCOLS FOR MULTIPLE INJURED PATIENTS OR MASS CASUALTIES

Initial TB, TRIA, TRAUMA RESUSCITATION, AND TRANSPORT SHOULD FOLLOW STANDARD PROTOCOLS FOR MULTIPLE INJURED PATIENTS OR MASS CASUALTIES

FIND 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

- Spacing – Apathe, tachypnea hypoventilation, hypoxia and cyanosis, cough, wheezing, dullness to percussion, decreased breath sounds, or hemoptysis

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YES

VITAL SIGNS, OXYGEN, MONITOR IV

Appropriate Treatment and Transport

Blast Event

MANAGEMENT

OXYGENATION

- High flow, sufficient to prevent hypoxia via non-rebreather mask, CPAP, or endotracheal intubation
- Hemotherax or Pneumothorax
- Close observation for any patient suspected of BLI for the development of tension pneumothorax transported by air

AIR EMBOLISM

- Position in prone, semi-lateral (lateral), or semi-lateral position, 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 emboli
- "Most lab and diagnostic testing conducted per resuscitation protocols – based upon nature of explosion (e.g. confined space, fire, etc.)"

HOSPITAL DISPOSITION AND OUTCOME

- All patients with suspected or confirmed BLI should be observed in the hospital
- 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 casualties, all had normal physical examinations and chest radiographs and most had normal pulmonary function tests

Blast Event

AIRWAY MANAGEMENT PROTOCOL

- If suspicious for BLI or is intubated, patients should be intubated; oxygen should be used as positive pressure and mechanical ventilation may increase the risk of further pulmonary injury

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
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