

BLAST INJURIES

Radiological Diagnosis



Background

Explosive events have the potential to inflict numerous casualties with multiple injuries. The complexity of this scenario is exacerbated by the fact that few providers or medical facilities have experience with mass casualty events in which human and material resources can be rapidly overwhelmed. One significant difference between explosion-related injury and other injury mechanisms are the number of patients and multiplicity of injuries which require a higher allocation of resources. With this caveat, the appropriate utilization of radiology resources has the potential to impact in-hospital diagnosis and triage and is an essential element in the optimizing the management of the explosive injured patient.

Initial Evaluation

Primary Blast Injury is caused by the overpressure blast wave produced by high-order explosives, primarily affecting air-filled organs and cavities such as the ear, lung, and abdomen. This blast wave is magnified by the reflection of surfaces as seen in closed-space explosions (e.g., inside a building, bus, train).

Radiological diagnosis of **primary blast injury** focuses on pulmonary and enteric barotrauma. Pulmonary barotrauma is characterized by pulmonary opacification secondary to diffuse pulmonary alveolar hemorrhage and pneumothorax.

- Patients with substantial pulmonary blast injury often present with significant pulmonary symptoms which may include dyspnea, tachypnea, and cyanosis. A chest radiograph is a confirmatory test.
- In the absence of peritonitis or clinical signs, the role of radiological studies in assessing primary blast injuries is to identify enteric injury manifesting as intraperitoneal free air. Computerized tomography (CT) has a much greater sensitivity for the detection of intraperitoneal free air than does conventional radiography.

Secondary Blast Injury is characterized by trauma due to impact from bomb fragments, to include the casing of the bomb in addition to objects added to the device to increase lethality (e.g., screws, nails, nuts and bolts). It can also result from debris external to the bomb that is secondarily propelled by the explosion. Secondary blast injury primarily causes penetrating trauma, but may also cause blunt trauma. Patients can sustain penetration of any region of the body, and typically have fragment penetrations in multiple body regions.

Radiological diagnosis of **secondary blast injury** helps to prioritize treatment by identifying life-threatening injury that may require timely intervention. For example, radiological imaging can be used as follows:

- Portable biplanar x-ray can be used to define basic penetration patterns.
- Conventional x-ray can be used to identify patients with fragment wounds suspicious for causing intracavitary injury, who then will require more advanced methods of imaging. (Conventional x-ray is not sensitive for body cavity penetration.)
- The thoracoabdominal CT scan can be used to identify unapparent injuries, including among hemodynamically stable patients with blast fragment penetrations.
- The CT scan can be used to identify patients injured by fragments who do not need surgical therapy.

Initial Evaluation (continued)

Tertiary blast injury results from the victim being thrown by the force of the blast wind. These injuries primarily involve blunt trauma, but may also be classified as penetrating trauma (e.g., impalement on sharp object).

Radiological evaluation of **tertiary blast injury** primarily focuses on identifying fractures, but also includes the detection of other injuries. For example:

- Plain films are useful in evaluating the thorax for signs of pneumothorax, hemothorax, or pulmonary contusion, as well as stigmata consistent with acute thoracic aortic injury.
- Pelvic radiography is used to exclude or to determine the morphology of pelvis fractures.
- Focused abdominal sonogram for trauma (FAST) can be used to rapidly diagnose the presence of intraperitoneal fluid in patients with blunt-force trauma injuries. In explosive events, this fluid is presumed to be blood.
- Similar to the diagnostic algorithm for the secondary blast injury, the CT scan is both sensitive and specific for determining traumatic pathology.

Summary and Disposition

The severity and diversity of injuries caused by explosions provide treatment challenges for emergency medical providers.

- Due to the potential for surge and nearby hospitals following an explosion, effective use of radiology resources is vitally important during patient triage and in identification of patients with the greatest need of life-and-limb saving interventions.
- If radiography resources permit, imaging should be used liberally in the acute diagnostic phase to increase the accuracy of diagnosis and enhance treatment.

This fact sheet is part of a series of materials developed by the Centers for Disease Control and Prevention (CDC) on blast injuries. For more information, visit CDC on the Web at: www.emergency.cdc.gov/BlastInjuries.