Mass Casualty Incidents

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Disclosures

- None
- This presentation does not necessarily represent the views of the US Department of Defense or Department of Veterans Affairs

Objectives

- At the conclusion of this presentation, learners will be able to answer the following questions:
  - What is a mass casualty incident?
  - What is the epidemiology of mass casualty incidents in the US?
  - How is a mass casualty incident run, both in the field and hospital?
  - What types of injuries are commonly seen?
  - What can I do at the scene to help?

Mass Casualty (aka MasCal)

- Definition:
  - **Any incident in which the number of patients exceeds the capacity of the local healthcare system (EMS & hospitals) to care for them**

Types of Incidents

- Can be mundane
  - Pile-up with multiple patients
  - House fire with several patients
  - Drive-by shooting with several patients
- Or Not
  - Explosions
  - Train derailments
  - Mass shootings
  - Chemical incidents
  - Acts of war

MasCal as a Disease?

- The number of mascal incidents is on the rise
- Greatest proliferation is in mass shootings

Epidemiology of Mass Shootings

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Differences in Mass Shootings vs Conventional Shootings

- Weapons typically are assault rifles
  - Large capacity high-velocity rounds
  - Handguns (lower capacity and smaller lower-velocity rounds)
- Larger cavitation and tissue destruction
- Shooters frequently more experienced using their weapons
  - Better accuracy and better “kill shots”
- Mass shooters frequently not concerned with escape
  - Keep killing until they die

Ballistics 101

- Depends on muzzle velocity (rifle vs handgun vs shotgun) and type of projectile (bullet size, hollow point vs jacket, shot)
- Temporary vs permanent cavity in tissue
- Yaw (tumble) of projectile in the body

Ballistics 101

Ballistics 101

Blast Injuries

Blast Injuries

- What are they
- What should I look for
- What don’t I want to miss

Types of Blasts

OK for Real Now

- Thermonuclear
- Thermal
- Chemical
- HE

Thermonuclear Blasts

- Greatest potential destruction
- Least likely type of injury you will see
  - Hardest to obtain
  - Most likely that you will be vaporized as well
- Combine the features of many other types of blast injuries with radiation and intense heat
- Major addition is radiation exposure
- Otherwise similar to HE blasts

Thermobaric

- AKA fuel-air explosives
- Mix of gases or droplets in air
- Causes explosion with intense flame component

Examples of Thermobarics

- Dust/air mixtures in silos
- Slowly-escaping natural gases
- BLEVE (boiling liquid-expanding vapor explosions)
- Munitions
  - Usually designed to be BLEVE-type blasts

HE Explosives

- Have a high reaction rate
  - Aka the conversion is quick
  - Called a detonation
  - Generate a blast wave

Anatomy of an Explosion

- Consider the case of HE blasts
- Detonation creates gas at high temp & pressure
  - Example of C4-over 4 million PSI
- This causes blast wave
  - Rapid omnidirectional pressure front
- This rapid rise in pressure is called overpressure

Anatomy of an Explosion

- Overpressure
  - Primary cause of injury/death
  - Peak overpressure wave of 60-80 psi lethal
  - Caused by transfer of energy to the body

Determinants of Injury

- Peak of overpressure wave
- Duration of overpressure
- Medium of explosion
- Distance from initial blast wave
- Focusing
  - Reflection off other surfaces
  - Worse if it occurs in enclosed space

Determinants of Injury

- Greatest damage occurs at transition points of tissue
  - IE tissue/bone junction
- Pressure-sensitive locations
  - Barotrauma-lungs, eardrums

Determinants of Injury

- Blast winds
  - Large release of gaseous products causes “winds”
  - These can cause a great deal of secondary injury
  - Even low intensity blasts can cause a great deal of winds

Injury Patterns

Specific Injuries

- Primary blast injury
  - Due to pressure wave
  - Seen with HE explosives
- Secondary injury
  - From projectiles
  - Body turned into a projectile
  - Heat

Specific Injuries

- Burns
  - Manage as any other burns
  - Burns rarely in isolation
  - ALWAYS look for additional injuries

Specific Injuries

- Sharpnel
  - Beware penetrating trauma
  - Pinholes can herald big trouble
  - Have an exceptionally low threshold to consider vascular injury
  - Beware complex devices
    - Shrapnel that is radioactive
    - Covered with feces, blood, etc

Specific Injuries

- Amputations
  - Seen commonly with HE blasts
  - A great deal of force released at bone/ST junction
  - Tearing mechanism
    - Usually limits vasospasm
    - Can have massive blood loss
  - Need urgent hemorrhage control
    - TK
    - Guillotine amputation

Specific Injuries

- Barotrauma
  - Can be immediate or delayed
  - Barotrauma in one anatomic region usually means in others
    - Beware isolated “TM perf”
    - Frequently develop associated barotrauma

Barotrauma

- Overpressure causes alveolar rupture
- Leads to pneumothorax, SQE, pneumomediastinum
- Most common pulmonary injury is contusion
- Can also develop systemic air embolism
- CXR usually diagnostic

Barotrauma

- Eardrum
  - May be associated with other barotrauma
  - With lower pressures may see hemotympanum without rupture
  - May not see eardrum injury in certain cases
    - Wearing ear protection
    - Body in water, head out of water during underwater explosion

Barotrauma

- Most common type of blast injury barotrauma is to ears
  - 35% of OKC blast victims had TM involvement
- Severe injury may have permanent hearing loss

Barotrauma

- GI
  - May see pneumoperitoneum
  - May not see pneumoperitoneum; may have perf or hemorrhage instead
  - Colon site of most GI barotrauma
    - Most air filled part of GI tract
  - Look for signs of acute abdomen
  - Presentation frequently subtle

Neurotrauma

- Can be from penetrating injuries
- Can also be from overpressure
  - Can be DAI
  - Also concussion
- Repetitive trauma from blast injuries current research topic
  - Using markers like NFG proteins and s100b

Secondary Injuries

- Can be from debris
- Can be planned
  - Suicide vests with ball bearings
  - EFP’s
  - Cluster munitions

Other Principles

- Scene safety
  - If terrorist incident suspected remember that second device may be around
  - Unsafe structures
    - WTC
  - Radiation if nuclear blast

Management Principles

- ICS (Incident Command System)
  - Mandated by FEMA for hospitals/municipalities/EMS
  - Provides organized structure from scene of incident into hospital
  - Open communication between field and facility
  - Provides for triage, initial stabilization, and transport from scene
  - Hospital-surge capacity, additional resources

The ICS

Field Management

- Most EMS agencies use START (Simple Triage and Rapid Transport)
  - Assigns patients to one of 4 color codes
  - Black-dead
  - Red-immediate
  - Yellow-urgent
  - Green-walking wounded
- Patients without a pulse are usually not resuscitated
- Patients who are critically injured take priority
- Coordinated response with field & hospital IC’s to distribute patients appropriately

Hospital Management

- IC staff (usually senior leaders) staff command center
- Call in appropriate backup staff; open OR's; extra radiology & lab availability; blood supply; open up outpatient areas as ED overflow
- Plan for inpatient surge capacity
  - Open up unused floor beds
  - Facilitate rapid discharge and bed cleaning
- Support staff on hand for debriefing of providers (EMS & hospital) after the incident is over

Summary

- Mass casualty incidents becoming more common
- Most likely MCI’s are shooting or explosives
- Most shootings likely to be with military type weapons
- Blast injuries have unique injury patterns rarely encountered in civilian life
- Hospitals need surge capacity plan to handle a sudden influx of severe patients

Questions?

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