Less Lethal Weapon Injuries

Presented by MedicEd.com, Inc.
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2 Credit Hour Course Approved for the Following Levels:
» First Responder
» EMT Basic
» EMT Intermediate
» EMT Paramedic

Objectives
The objectives of this lecture is to give the EMS responder insight into to the Less Lethal Weapons that are being deployed by Law Enforcement agencies and the potential injuries that they may cause to the patient. In the lecture we will look at several key points:
✓ Type of Less Lethal Weapon System used (LLWS)
✓ Issues that may affect the EMS provider
✓ Common injuries associated with a particular LLWS
✓ Prehospital care of different LLWS injuries

Introduction
- Law enforcement agencies across the country have adopted Less Lethal Weapon Systems to better deal with suspects that in the past may have resulted in the law enforcement officer using deadly force. These less lethal weapon systems come in a multitude of forms. Let’s start with the most basic and work our way to the most advanced.
Available Less Lethal Weapon Systems
A quick look at the Less Lethal Weapon Systems available to law enforcement is quite impressive.

- Baton
- OC/CN/CS
- Pepperball
- FN303
- Shotgun
- 37/40 MM Launcher
- Grenades
- Taser
- K9

Circumstances to use a Less Lethal Weapon System
Now let's look at the circumstances under which the law enforcement officer may use a Less Lethal Weapon System:

- Hostage incident
- Barricaded subject/Cell extraction
- Large disturbances/Jails/Prisons
- Suicide by cop
- When lethal force is not appropriate

LLWS Subcategories
We can further divide these LLWS into subcategories and discuss how they work on the subject.

- Aerosol/Chemical Agents
- Impact Weapons
- Electrical/Stun Devices
- Other

Aerosol/Chemical Agents

- OC – Oleoresin Capsicum
- CN - Chloracetophene
- CS – O-Chlorobenzal-malononitrile

Impact Weapons

- Baton
- Pepperball
- FN303
- Shotgun
- 37/40 MM Launcher
- Distraction Devices

Electrical/Stun Devices

- TASER
In most cases, if an officer is confronted with a resistive subject, one of the first options is to use one of the aerosol/chemical agents to gain compliance. These agents are applied to the subject's facial region to achieve the maximum effect. By design, these aerosol/chemical agents are intended to target the following areas:

- Eyes
- Respiratory System
- Mucus Membranes
- Skin

**Application / exposure of aerosol/chemical agents to the eyes**

When aerosol/chemical agents enter the subject’s eyes, the eyelids will immediately close to protect the eyes from further damage. The OC will make contact with cornea and cause a severe burning sensation that can last a few minutes to an hour depending on several factors.

- Scoville Heat Units (SHU’s)
- Amount of contamination
- Distance from the aerosol/chemical agent’s nozzle to the subject’s eyes.

**Scoville Heat Units (SHU’s)**

- A measure of how hot the OC is, based on the amount capsicum or capsinoids in the mixture. The relationship between the SHU’s and recovery time of the subject are directly proportional.

- If officer A sprays a subject with 5% OC 2 million SHU’s and officer B sprays a subject with 10% OC 2 million SHU’s the subject sprayed by officer A should recover quicker all things being equal.

**Amount of contamination**

- If the subject had to be sprayed several times, then we have more agent to decontaminate from.

**Distance from the aerosol/chemical agent’s nozzle to the subject’s eyes.**

- Most manufacturers recommend that the aerosol/chemical agents be deployed no closer than 4-6 feet. The OC in the can is under a significant pressure, and if too close to the subjects eyes can cause temporary or permanent injury

- The subject below was sprayed with 10% OC 2 million SHU’s from a measured distance of 6 feet. The individual was decontaminated with Johnson & Johnson’s baby shampoo, water and circulated air via a commercial fan.
This picture was taken approximately 2-3 hours after the initial spray. The subject complained that it felt like a piece of sand was still in his eye. You can also note that the patient's left pupil is larger than the right. Both pupils were round and reactive to light. All eye movements were coordinated and no deficits were noted during the exam. He was sent to the Emergency Department and treated for chemical conjunctivitis with ophthalmic ointments and made a full recovery. The physicians were unable to explain why he had the pupil dilation in only one eye.

Treatment for Ocular Exposure to aerosol/chemical agents
Once the scene is safe and the subject has been decontaminated enough so that he/she can be treated, the evaluation can be completed. By this time we have completed the primary and secondary survey and determined that there are no life threatening emergencies that need our immediate attention. Complete a thorough exam of the eyes. This should include but not be limited to:

- Checking the conjunctiva for redness
- Deformity of any part of the eye
- Testing the eye for PEARL (Pupils, Equal, And, Reactive to Light)
- Testing for ocular motor movements – up/down & left/right
- Field sight test – How many fingers do I have up?

If the patient is unable to open their eyes (blepharospasm) for an exam the best treatment option is to continue to gently flush the eyes with continuous flowing sterile water for 10-15 minutes and recheck. Some patients feel that the water reactivates the OC and would rather sit in front of a fan or just face into the wind. In either case the chemical agent needs to be removed from the surface of the eye for the irritation to subside.

Application / exposure of aerosol/chemical agent to the respiratory system
If the subject inhales or ingests the aerosol/chemical agent into the respiratory system, the subject may exhibit some of the following symptoms.

- Coughing
- Shortness of breath
- Vomiting

As the aerosol/chemical agent enters the respiratory system, it will cause discomfort and inflammation. This discomfort and inflammation will cause coughing which can be severe at times and may cause the subject to vomit from the coughing spasm. The body's natural defense is to attempt to expel the foreign material that has entered. The bronchi will also release a small amount of fluid in response to the irritation and inflammation. The patient now has to clear the foreign particles and the secretions that have built up in response to the OC.

Treatment for Respiratory Exposure to aerosol/chemical agents
Patients that have been exposed to aerosol/chemical agents should be watched closely for any respiratory complications. As with any exposure, the scene should be safe and the patient be decontaminated enough so that the EMS provider can complete a primary and secondary survey. If no life threatening conditions are present, a detailed respiratory exam should be completed. This should include but not be limited to:
EMS providers would be prudent to listen to the subject’s lung sounds and note any abnormalities. This may be difficult if the subject is having a coughing spasm. These patients may be agitated and complain that they are having trouble breathing, shortness of breath, or be unable to take a full breath without coughing. The patients need to be reassured by EMS that they (EMS) are doing everything they can to make the patient comfortable and treat their condition. Patients that have been sprayed/exposed to OC frequently have OC on their shirt or outer clothing that will off gas after the exposure and continue to exacerbate the situation. The treatment is to remove the clothing that is contaminated and, either dispose of it, or seal it in two plastic bags clearly marked that it is clothing contaminated with OC.

Pulse oximetry can be a useful tool if available. Patients are continuously monitored or checked every five minutes until they return to a more normal respiratory rate and rhythm. Any drastic changes in the SPO2 need to be addressed. EMS providers may see changes in the SPO2 values when the patient goes into coughing spasms or vomits. These values typically will return to normal after the coughing or vomiting terminates. If the values continue to change, O2 levels decrease and do not return to normal, or the pulse rate continues to climb, there is cause for concern. Subjects that have been sprayed/exposed to aerosol/chemical agents tend to have a higher than normal pulse rate in response to the event at hand. The sympathetic nervous system was activated and it caused the adrenal glands to secrete adrenalin into the blood stream. This is going to cause a rise in the pulse and blood pressure. As the patient’s anxiety level comes down, the patients pulse and blood pressure usually correspond as well. If they do not respond accordingly, there could be some other underlying issue.

Some patients may request or need supplemental oxygen after the exposure. Patients will be best treated with a simple mask or a non-rebreather depending on their condition. Some subjects will request oxygen but will find it difficult to keep in place if they are having coughing spasms.

Patients with a history of respiratory diseases such as asthma or COPD need to be watched closely for any changes. If the subject presents with wheezes, oxygen desaturation, or tells you it feels like they are having an asthma attack, ALS (advanced life support) should to be requested.

**Application / exposure of aerosol/chemical agents to the mucus membranes**

A person sprayed/exposed to OC may get some of the agent into the nasal passages. OC’s inflammatory characteristics will cause the mucus membranes to secrete an abnormal amount of discharge. This is usually characterized by a large amount of discharge from the nose. Of the four areas affected by OC, the mucus membranes seem to recover the quickest and cause the least medical complications. Patients should be encouraged to blow their nose and try to get the particles and discharge out of their nose.
Patients that have chemical agents applied to bear skin will often complain of severe burning sensation at the site of the exposure.

**Application / exposure of aerosol/chemical agents to the skin**

The individual above was not sprayed directly with chemical agent but had what appeared to be a reaction to his skin from the chemical agent. This subject had urticaria that rapidly traveled to about sixty to seventy percent of his body in less than an hour. This individual did not have any shortness of breath or exhibit any wheezes on auscultation of his lungs, and SPO2 was within normal limits. The patient did not wish to be transported to the local emergency room, but was encouraged to call his primary care physician (PCP).

**Impact Weapons**

- Baton
- Pepperball
- FN303
- Shotgun
- 37/40 MM Launcher
- Grenades

**Impact Weapons - Baton**

The police baton, once the primary tool of choice of law enforcement, has been replaced by OC and the TASER. A formidable weapon in the hands of a skilled user, it can also cause relatively minor to lethal injuries. Most police agencies advocate that the officer use the baton to strike areas covered in a dense layer of muscle with no vital organs underneath it. If the subject is struck with the baton in a muscular area such as the thigh, you can expect the subject to have a high degree of pain in the area.

**Treatment protocols would include:**

- Pulse – does the extremity have a palpable pulse?
- Motor – can the patient move the extremity without pain?
- Sensory – does the subject have feeling in the extremity?
- Color – has the extremity changed color or tone at all?
- Temperature – is the extremity normal temperature?

As with any injury, if it is possible that there could be an underlying fracture, the extremity should be splinted in place. With a strike to a muscular area, the EMS provider may provide an ice-pack to reduce swelling and provide some pain relief; as long as it is with in local/regional protocols.
Strikes or jabs that make contact with areas that can lead to serious injury or death need to be closely examined. These areas include but are not limited to:

- Head
- Neck
- Collar bone
- Chest
- Abdomen
- Back
- Spine

**Impact Weapons - Baton**

When completing the primary and secondary survey on individuals that have been struck with the baton, think about the vital structures that are below it. We know from our training that the head holds the brain and severe strikes can cause some of the following symptoms.

- Brain Swelling
- Decorticate Posturing
- Decerebrate Posturing
- Irregular Breathing Patterns
- Altered Mental Status

The neck in particular has several vital structures that, if struck, could potentially cause severe or lethal injuries. Some of the structures include…

- **Anterior**
  - Trachea
  - Esophagus

- **Lateral**
  - Carotid Arteries
  - Internal Jugular Vein
  - External Jugular Vein

- **Posterior**
  - Cervical vertebrae 1-7

A downward strike to the collarbone has the potential to become a life threatening injury. The subclavian artery and vein run underneath the collarbone and, if struck forcefully enough, a fragment of the bone or the bone itself can cause a tear in the artery or vein. This type of injury becomes difficult to treat due to the fact that it is internal and that it involves large vessels. If you suspect this, follow local/regional protocol. These protocols should include:

- Activation of ALS
- To provide IV fluids as the patient can rapidly loose large volumes of blood internally
- High Flow O2
- Splinting/Stabilizing of extremity
Impact Weapons - Pepperball

The PepperBall launcher system is very similar to a paintball gun that fires specially designed spherical rounds that resemble paintballs. The weapon system is powered using compressed gas that forces the round out of the weapon and towards the intended subject. The typical round for law enforcement has PAVA (pulverized OC) contained inside. By design, the round makes contact with the target and breaks open releasing the PAVA. The target subject will have pain associated with the impact of the round and also be affected by PAVA. The effects of the PAVA will mimic the effects of a subject that was exposed to an aerosol/chemical agent.

These patients are usually easy to decontaminate in the field since the PAVA is delivered in powder form. Have the subject remove the contaminated clothing and bag it as was discussed earlier. The EMS provider should examine the site of the impact and look for:

- Impalement
- Bruising/Contusions
- Bleeding

Impact to the chest at any distance should include examination for:

- Difficulty Breathing
- Shortness of Breath (SOB)
- Flail Segment
- Crepitus
- Asymmetric inspiration and expiration
- Blood in the phlegm
- Diminished or absent lung sounds

Any of the previously discussed signs should be taken seriously by the EMS provider and treatment options quickly evaluated. The shortness of breath and difficulty breathing could be caused by the PAVA powder, or could be caused by one or more of the following:

- Pulmonary Contusion
- Punctured Lung with Pneumothorax or Tension Pneumothorax (air between the lung and chest wall)
- Hemothorax (blood between the lung and chest wall)
Pericardial Tamponade
All of the conditions listed above are best treated by Advanced Life Support providers.

Impact Weapons - FN303

The FN303 operates very similarly to the Pepperball System, except the speed at which the projectile travels and the weight of the projectile. The FN303 projectile weighs more than the Pepperball round and travels at a faster rate of speed. This means that the FN303 can deliver more energy when the round impacts the subject. The injury patterns are going to be very similar to the Pepperball system.

In an incident in October 2004, a young female was shot in the eye with a FN303 projectile. The projectile penetrated her eye and caused internal bleeding within her brain and she succumbed to her injuries.

Impact Weapons - Shotgun

The most versatile weapon system at the disposal of most law enforcement departments. The shotgun can deliver lethal rounds, less lethal rounds, and with an adapter, launch a variety of grenades out to 100 yards with some accuracy. Some of the less lethal rounds include but are not limited to:

- Bean Bag
- Fin Stabilized
- TASER Rounds
- Single Ball
- Multi-Ball
Other rounds include:

- Breeching Rounds
- Ferret Rounds
- Distraction Rounds
- Barricade Rounds

The rounds travel at a much faster rate of speed and the weight of the projectile is significantly greater than that of the Pepperball or the FN303. As mentioned earlier, the faster the speed and the greater the weight of the projectile, the higher the risk of bodily injury to the subject. Over the years several deaths have been caused by munitions/rounds fired from shotguns.

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**Case #1**

48-year old female shot twice with a bean bag round. One round impacted her torso, the other round struck her arm. The coroner found that the cause of death was a laceration to the heart due to blunt force trauma.

The beanbags to the left are the older style that had some issues with accuracy over long distances. There are reports that these beanbags would open in flight and spin end over end, creating a “buzz saw” effect that would cause traumatic damage to the intended subject.

On the right are the more accurate beanbags, accuracy was greatly improved with the modification of bag itself and the addition of the tail.

**Case #2**

61-year old female with Osteoporosis. The subject was shot with bean bag rounds to gain compliance. Suspect sustained three broken ribs, one of the ribs splintered and punctured her heart.

**Case #3**

Male suspect shot with a bean bag round after he refused to stop mutilating himself. Bean bag penetrated the skin and entered the body. The suspect died from severe blood loss.
This subject was shot with a multi-ball round. Note that the subject has several “pot-marks” where the rounds made contact. Also note the mark to the medial aspect of the left eye. A couple of centimeters to the left or right and the subject may have lost his eye.

What do you see for possible injuries in this subject?

- **Lung**
  - Lung Sounds?
  - SOB?
  - Difficulty Breathing?
  - SPO2 Readings

- **Spine**
  - Feeling?
  - Motor?
  - Sensory?

- **Kidney**
  - Blood in urine?

How would you treat this patient?

- Items to consider?
- C-Spine Precautions
  - Collar
  - Board
- O2 – with that particular injury to the right posterior lung it would be prudent to monitor the SPO2 and evaluate lung sounds at five minute intervals for any changes

Trauma Center or Nearest Local Hospital?

- I am going to go with the Trauma Center. With the number of rounds he absorbed he is going to need X-rays, CT scans and blood work done to see the full extent of his injuries.

Impact Weapons - 37/40mm Launchers

The 37/40 launcher is favored by SWAT (Special Weapons and Tactics) teams due to the varied munitions that can be fired from it.
There are numerous rounds that can be fired from the 37/40MM launcher. Listed below is a partial list.

- Wooden Baton (center picture)
- Rubber Baton (right)
- Bean Bag (Upper right / two types)
- Muzzle Blast
- Multi-Ball Round
- Ferret

As can be seen below the beanbag round can leave a distinctive mark on the subject. This subject will probably exhibit pain at the site of the impact and have localized swelling. In evaluating his wound the EMS provider needs to think about what structures are below the site of the impact and how we can best treat the patient.

- How would you treat this patient?
  - Evaluate for
    - Distal pulse
    - Motor ability
    - Sensation
- Splint in POC (position of comfort)
- ICE-Pak

Impact Weapons - Taser

The TASER (Thomas A Swift Electric Rifle) is probably the most advanced less lethal weapon available on the market today. The TASER can function in two different modes:

- In the first mode the TASER will deploy two darts utilizing compressed gas. The barbs on the darts impale themselves in the skin and the electrical impulse travels from the handheld unit along the filament line to the darts. The electrical impulse then enters the body through the darts and is controlled by the TASER operator,
- The second method is the “dry-stun” in which the TASER is held directly against the skin (darts removed) and the electrical impulses are delivered to the subject.
The TASER electrical impulses delivered by the TASER override the nerves and cause the muscle group’s involved to contract. In most cases these electrical impulses make it virtually impossible for the subject to resist. The official term for this effect is Neuro-Muscular Incapacitation. The author has been TASERed on two occasions, on both occasions he was unable to voluntarily provide any resistance and was guided to the ground.

**TASER Electrical Information**
- High peak arcing voltage 50,000v
- M26 peak voltage across the body – 5000v
- X26 peak voltage across the body – 1200v
- Low Average current <0.004A
- Energy delivered per pulse
  - M26 0.5 joules
  - X26 0.07 joules

The majority of injuries that occur from the TASER may not actually be from the TASER itself, but from the fall the subject sustains after being TASERed. As the subject is in the process of being TASERed he/she is unable to fall in a controlled decent. This uncontrolled decent sometimes causes the subject to fall quickly and in some cases strike an object on the way down with a part of their body.

Depending on the EMS service, some regional protocols will allow the EMS professionals to remove the darts/probes in the field as long as the dart/probe is not in one of the following areas.
- Head
- Face
- Throat
- Groin
- Breast (female)

To remove the dart/probe in the field, if protocol dictates, make an L with your thumb and pointer finger adjacent to the probe/dart. Grip the dart/probe with the other hand and pull straight back, pulling the dart/probe out of the skin. Check area for other injuries, cleanse area and cover with dressing.

For areas that do not have protocol to remove the darts/probes in the field, simply treat the darts/probes as impaled objects and splint in place and transport to the nearest appropriate hospital.
Since June 2001 more than 70 people have died in police custody in the US and Canada after being struck with TASERs. For this particular reason subjects that have been TASERed should be closely watched for adverse effects and life-threatening injuries. There are some special cases that EMS providers should be aware of:

- The elderly – if a patient has a pacemaker or an internal defibrillation unit, the patient should be taken to the emergency room to have an EKG and/or 12 lead EKG to ensure that the internal units have not been affected. According to TASER the joules utilized by the TASER operate well below the level to have any effect on either unit.
- Pregnant patients – any patient that reveals or expresses to the EMS provider that they are pregnant or maybe pregnant should be evaluated in the emergency room.
- Minors - Any individual that could be considered a minor by state statute should be evaluated in the emergency room.

Distraction Devices

The majority of SWAT teams will utilize one of the following types of grenades to mitigate a situation. Below is a partial list of the ones that are available to law enforcement agencies.

- Flash Bang/Distraction Device (DD)
- Sting Ball grenade
- Triple Chaser grenade
- OC/CN/CS grenade
- Smoke grenade

- Flash Bang/Distraction Device (DD)
  - At detonation it emits a large bright light and loud noise to distract the suspects

- Sting Ball grenade
  - Is loaded with small rubber balls that are ejected at a high rate of speed when detonated. These sting balls can also be loaded with chemical agent to work in conjunction with the rubber balls

- Triple Chaser grenade
  - A three phase chemical grenade that breaks apart in three separate sections making it difficult for subjects to throw it back at law enforcement

- OC/CN/CS grenade
  - Single phase grenade that expels its payload of chemical agent
- Smoke grenade
  - Typically used to mask movement or used in conjunction with chemical agents to suspend the chemical particles in the air

Suspects that come in contact with these types of devices can suffer from several different issues. Below is a list of possible injuries that can occur:
  - Burns
  - Over pressure Injuries
  - Gross Contamination/Hypoxia

In these cases, Tactical Emergency Medical Service personnel are trained and skilled to provide advanced airways skills while wearing a gas mask or SCBA.

Burns
  - Subjects that attempt to pick up devices that are discharging their payload or have just finished delivering their contents can incur first to third degree burns to their hands or whatever body part makes contact with the device

Over pressure Injuries
  - Some distraction devices (DD) discharge an over pressure wave when they detonate. If the subject is too close to the DD the patient can suffer temporary or permanent damage to the tympanic membrane. If the device is very powerful and used in a closed space the patient can suffer injuries to the lungs and hollow organs

Gross Contamination/Hypoxia
  - There maybe occasions when multiple devices are used to force an individual out of an area. With several devices discharging their respective payloads, the oxygen saturation in the space may become too low to sustain life. In these cases the subject may become hypoxic and need immediate medical care while still contaminated with chemical agents.

The police dog or K9 is part of a multitude of law enforcement agencies. These dedicated heroes chase and/or track down the bad guys and give them a “touch of love” with a bite. These bites are not typically serious enough to cause life-threatening injuries unless the bite is on the trachea or punctures the femoral artery.

A regular bite to the arm or leg will most likely cause some type of crush injury from the intense jaw pressure, some bleeding from the puncture of the teeth and possibly some skin or muscle tearing from the K9 thrashing back and forth. Treatment for these injuries may include the following treatment:
  - Cleanse the area with normal saline, sterile water or irrigate with clean water
  - Check affected limb for Pulse, Motor and Sensory deficits
  - Apply a proper dressing to cover the wound
  - Find a position of comfort and splint in place if applicable