Clinical Practice Guideline (CPG)

Medical Implications of Police Less Lethal Technologies (CPG1)

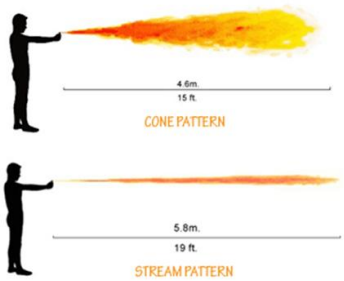
GOAL

This CPG provides an overview of selected police less lethal technologies. It presents a standardized approach for providers in the evaluation and treatment of patients with actual or potential injuries or effects, based in part upon an increased kinematic understanding of these technologies.

OLEORESIN CAPSICUM (OC)

Background

Pepper spray, more properly oleoresin (o-lee-o-rez-in) capsicum (cap-see-cum) is a powerful, natural, biodegradable, non-persistent, inflammatory agent found in cayenne peppers. In typical police formulations, the active ingredient, capsaicin, appears as an oily, amber-orange extract suspended in a non-flammable carrier, usually distilled water. The effects of OC vary from person to person. Formulas of varying Major Capsaicinoid Content will also cause reactions to vary. For typical patrol use, Ontario police services individually issue small (~90 mL), belt-mounted, canister dispensers which expel a liquid stream ~2-3 m. In prisoner cell locations, a foam-based product is often substituted, to decrease cross-contamination in confined spaces. For public order/crowd management duties, larger (~385 mL) canister dispensers (resembling a small fire extinguisher) which expel a liquid stream ~4-6 m are routinely utilized. Most manufacturers offer different Major Capsaicinoid Content formulas, as well as choices between ‘stream’ or ‘conical’ spray patterns.



OC uses its primary, inflammatory effects to re-orient an individual away from aggression by rapidly affecting the eyes, skin, and respiratory system. The eyes may open and close in spasmodic fashion (blepharospasm) or remain involuntarily closed. Capillaries will dilate and result in severe reddening of the sclera and perhaps eyelid edema. Pain will be extreme and patients may complain of having had their eyes hit with hundreds of needles, having sand in their eyes, or that their eyes feel like they are on fire. Depending upon the degree of exposure and subsequent decontamination, these effects may last up to 60 minutes. Expect to see intensified eye effects at very close range if a high-intensity stream pattern impacts corneal tissues. Conversely, unless sprayed directly into the mouth and nose area, anticipate slightly-reduced respiratory effects, as the liquid stream is less effectively inhaled than a micro-droplet spray. Facial skin and mucous membranes of the nose and mouth will experience an intense burning sensation. Patients with a fair complexion or wet with perspiration may present with increased effects. Mucous membranes may also be edematous and/or discoloured from light yellow to bright red. If OC is inhaled, the respiratory system will be inflamed and the patient will be visibly short of breath and gasping for air, with gagging, retching and uncontrollable coughing. Auscultation of lung sounds in a severely distressed patient may detect an expiratory wheeze, a condition associated with restrictive lung problems such as bronchospasm. The patient may complain they can't breathe or that their throat and lungs are on fire. If sprayed while involved in a violent encounter, expect a marked increase in effects, since breathing is deeper and more rapid under exertion and stress.

Treatment

Exposure to small amounts of OC while decontaminating or caring for a patient is in no way directly dangerous, but it can be distracting and specifically vision-impairing. This has immediate implications for general situational awareness and both driving and medication administration safety. Proper PPE is essential. Minimally, the issued, full-faceplate North 7600 mask should be donned, ensuring P100 filters fit snugly. The North 5500 with goggles could be reasonably substituted, but any OC residue on the cheeks, below the edge of the goggles, may drift upwards into the eyes after doffing the goggles. Recall that P100 filters are rated for oily aerosols, but their capacity to filter OC is moderate and that protection will degrade quickly. Mask alone is sufficient for rapid, screening-type assessment of multiple persons in custody. For assessment of heavily contaminated patients and all field decontamination situations, at least one paramedic should don Tyvek suit protection and work utilizing an organized team approach.

Remove patients to fresh air, face them into the wind if possible and remember to stay upwind. Coach them to breathe normally and provide continual reassurance that the effects will pass. For patients whose skin is soaked or dripping with OC, first blot all such contamination from them, using 8”x10” gauze pads or the paper cleaning wipes stored in the vehicle bulkhead cabinet. Prioritize relief to the eyes and mouth initially and rapidly irrigate with copious amounts of cool, bottled water. Recall that OC is an oily suspension and more easily decontaminated with a surfactant (soap). If available, transition to a spray application of pre-mixed ‘no more tears’ baby shampoo, followed by liberal spray application of tepid, tap water from a garden-type sprayer. Repeat this at

least several times, perhaps as long as 15 minutes, for highly-symptomatic patients. Remove all outer clothing and as much other clothing as necessary to ensure only minimal contamination remains. Outdoor temperatures and handcuffs/other police restraints will have to be factored. Focus the shampoo/water spray on other body parts as required. Cold packs may be applied locally if burning persists. Absent of COVID-19 restrictions regarding aerosolizing interventions, bronchodilator therapy is safe in patients exposed to OC. Do not allow patients to rub their eyes. Contact lenses should be removed and discarded, as they cannot be safely decontaminated. For intense or persistent ocular symptoms, tepid temperature Normal Saline (500 mL or 1000 mL bags, depending on symptoms or transport time) can be spiked with a 10 gtt drip set to continue localized eye irrigation. Position the patient appropriately so as not to cross-contaminate a non-involved eye. Position an emesis container and/or absorbent pad to capture 'grey water' runoff. Isolate and place all contaminated clothing and decontamination wipes into plastic garbage bags to minimize cross-contamination.

After a call involving OC, if hard-surface vehicle contamination is suspected, open vehicle doors and windows and use exhaust fans to quickly evaporate any remainder. Recall that OC is completely biodegradable. Simple soap and water wipe of suspect surfaces is all that is required.

References:

LeClair, T.G., "Treatment of Pepper Spray Exposure." The American Society of Law Enforcement Trainers Journal, July/August, 1994, pp. 19-21.

LeClair, T.G., "Tactical Talk: Pepper Sprays." Emergency Prehospital Medicine, Vol. 6, No. 6, 1992, p. 20.

2-CLOROBENZALMALONONITRILE (CS)

Background

More commonly referred to as 'tear gas', CS is in fact not a gas, but rather a micro-crystalline powder. It is a potent, chemical, non-biodegradable, persistent, inflammatory, lachrymatory (causes eyes to tear heavily) agent. Prior to the widespread adoption of OC, it was often the agent of choice for certain applications, such as expelling a barricaded subject from a structure or discouraging access to open areas in crowd management situations. Still utilized for these purposes by some agencies, it may be deployed as a pyrotechnic (burning), 'grenade-type' device. CS is also available as a non-pyrotechnic, 'grenade-type' dispersal device or a non-pyrotechnic, blast dispersion cartridge which can be launched from 37mm launcher systems. With a slower onset of action than OC, from several seconds to minutes depending upon exposure levels, it has generally poor performance as a reactive, defensive spray.

CS has some effects similar to OC and patient's eyes will have excessive tearing, a severe burning sensation and blurred vision. Heavy mucous production and edema are often present in the nasal mucosa. Oral mucosa reacts to CS with a strong burning sensation, often with difficulty swallowing and drooling. Because the CS micro-powder is easily and deeply inhaled, patients will often experience chest tightness, strong and continued bouts of coughing and dyspnea, often associated with bronchospasm and wheezing. Nausea and vomiting are also commonly experienced. Skin will often be severely reddened and prolonged contact can result in a burning, itchy rash, progressing to chemical burns with vesicles (small fluid-filled blisters).

Treatment

Proper PPE is perhaps even more important when there is a potential for CS exposure. Recall that it is a persistent chemical agent and the fine micro-powder will find its way into the smallest crevices and onto the smallest amount of exposed skin. For particularly sensitive skin, continuous low-level exposure while caring for multiple patients, even for only a few hours, can result in contact dermatitis. The issued, full-faceplate North 7600 mask is highly recommended, with Tyvek suit PPE guidelines closely followed.

Remove patients to fresh air and face them into the wind if possible. It is particularly important to remember to stay upwind, because the micro-powder will quickly transfer to other people and surfaces. Remove any contaminated clothing and anything that needs to be pulled over the head should instead be cut away from the patient. Work this 'dry' decontamination in a controlled manner, despite patient complaint or protest. Rapid, expansive, physical movements, especially indoors or in a confined space, will only serve to cross-contaminate everything in proximity with CS. When disposing of clothing that has been removed, seal it in a plastic bag, being careful not to quickly expel air when tying it shut. Follow up by placing it inside another, to minimize cross-contamination. Absent of COVID-19 restrictions regarding aerosolizing interventions, bronchodilator therapy is safe in patients exposed to CS. It is imperative that contact lenses exposed to CS be removed and discarded, as the micro-powder will embed itself into the plastic matrix of the lens structure. Prolonged exposure can result in ulcerative and other eye changes that threaten a permanent decrease of visual acuity or even its loss. Progress to 'wet' decontamination of all affected skin with a spray application of pre-mixed 'no more tears' baby shampoo, followed by liberal spray application of tepid tap water from a garden-type sprayer. Repeat this at least several times, perhaps as long as 15 minutes, for highly symptomatic patients. Make every effort to prevent 'grey water' runoff from seeping into any remaining clothing or across otherwise uncontaminated skin, spreading the CS effects.

After a call involving CS, hard-surface equipment and vehicle contamination should be presumed. Vehicle doors should be opened, preferably parked where wind can assist in evacuating the mico-powder along with vehicle exhaust fans. Recall that CS is a non-biodegradable, persistent agent. Removal of the vehicle from service should be strongly considered, in consultation with the on-duty District Chief. Contaminated vehicle surfaces should be thoroughly wiped with hypochlorite (bleach) wipes after donning the issued, full-faceplate North 7600 mask and Tyvek suit protection.

References:

Advanced CBRN First Responder Training Program Course Manual, Defence R&D Canada, CFB Suffield, Canada, May, 2008.

NBC Unit Defence NCM Course Manual, Canadian Forces Nuclear Biological Chemical School, Canadian Armed Forces, CFB Borden, Canada, July, 1998.

"NBC Unit Defence NCM Course 9804" (Hill, Roy, Whitehall, Carson, Cloutier. Personal Communications / Course Notes, 13-24 July, 1998)

Toronto Police Service, "Use of Force Committee Final Report", Toronto, Canada, May, 1998.

CONDUCTED ENERGY WEAPON (CEW)

Background

Rapidly recognized by its brand name, TASER, use of a CEW to overcome physical resistance is a significantly advanced force option and has become the less lethal tool of choice for many circumstances. Potential for TASER injury may come from its use in either 'drive stun' or 'probe' mode. In drive stun mode, the CEW is 'driven' against soft-tissue pressure points of a subject, to gain control by means of pain compliance to verbal commands. As such, it is less likely to achieve control of individuals who are drunk, drugged or deranged. More commonly, the drive stun mode is used to contact a subject and complete the circuit when one of the probes has missed the intended target. In probe mode, two small, aluminum castings affixed with sharp, barbed probes are housed in a replaceable cartridge and propelled to a target by compressed nitrogen gas. Each probe remains tethered to its cartridge by a fine, insulated wire. These probes penetrate the soft tissue or clothing of a subject and discharge a pulsed, low energy (~3 j) charge approximately 20 times per second. Each trigger press results in a 5 second cycle. This charge overwhelms a subject's central nervous system by causing strong, involuntary muscle contractions, using a proprietary technology referred to as Neuro-Muscular Incapacitation (NMI).

The TASER has the potential for both direct and indirect injuries. The electrical energy used in drive stun mode usually results in superficial burns several millimeters in diameter, often accompanied by multiple minor abrasions, reflecting application against a struggling subject. All present, TASER-brand CEW's deliver less than 2 W of energy, far less than the Underwriters Laboratory Standard for common agricultural electric fencing at 5-7 W. Controversies regarding whether a CEW can cause death by electrocution at the VF threshold are related to direct myocardial penetration by the probe, a function of 'heart-to-dart' distance and generally not well supported. Utilization of a CEW does carry the risk of secondary injury from falls, since the basic principle of action is to override neuromuscular control. If this occurs in an elevated position such as a ladder, roof edge or staircase landing, injury risk is much higher and officers are

trained to consider these factors when electing to discharge the device. Falling onto hard or otherwise dangerous surfaces will obviously increase the risk of severe, secondary injuries. Direct penetration of ocular tissues can cause enucleation or unilateral blindness. Sparks from a CEW can ignite flammable liquids or gases at a scene. Use of a CEW on a subject who is in the water could result in submersion or drowning.

Treatment

Burns from a drive stun application require no special treatment aside from basic hygiene and observation for the development of any superficial infection. Probe removal is usually quite simple, since they rarely cause more than a small, superficial wound and can be treated with simple cleaning and appropriate dressings. Such injuries are generally uncomplicated and can be accomplished in the field unless embedded above the clavicles, in female breasts or in the genitalia. Steps to remove embedded CEW probes include: Ensure the wires from probe to cartridge are cut or cartridge is removed from CEW; Use gloves and other PPE as appropriate; Place thumb and forefinger of the non-dominant hand a few centimeters on either side of probe and spread them to tightly tension the skin surrounding the probe; Grasp the probe firmly with dominant hand and quickly pull (pluck) straight out; Inspect the probe to ensure it is intact and no fragment has been left in the wound; Wipe the wound with antiseptic or alcohol pad and apply adhesive dressing. The probe should be treated as a biohazard contaminated sharp and disposed of appropriately. Prolonged observation and diagnostic testing are not necessary in patients who are otherwise asymptomatic, not intoxicated and alert following a CEW exposure. This provides clinical support to the discharge of an unaltered, physiologically stable patient that has been exposed to an electrical weapon back into police custody, without extensive cardiac monitoring and laboratory workup.

References:

Kroll, M.W., et al., "Benefits, Risks, and Myths of Handheld Electrical Weapons." ***Human Factors and Mechanical Engineering for Defense and Safety, Vol. 3, No. 1, 2019.***

LeClair, T.G., Meriano, T., "TASER and Conducted Energy Weapons." Journal of Special Operations Medicine, Vol. 15, No. 4, 2015, pp. 52-57.

EXTENDED RANGE IMPACT WEAPON (ERIW)

Background

Impact weapons are designed for striking, jabbing or blocking, in an attempt to control a combative individual. Wooden 'billy clubs' were common with the dawn of modern policing in the early 1800's. Straight batons of wood or polymer and expandable metal batons remain standard issue today, but they are all close range weapons. When faced by a threat too dangerous to attempt close deployment of a baton, OC spray or TASER, yet not posing a threat that would reasonably require a firearm response, ERIW systems provide a baton-type response option, at the extended ranges imposed by threat or circumstance. Development of these systems grew out of rioting and violence in Northern Ireland in the late 1960's. The technical challenge was to develop a system that would deliver a blow sufficient to disable, but out of 'rock throwing' range (~20-40

m) of a crowd. The early answer was to adapt ‘tear gas guns’ to fire large-diameter (originally 1.5”), solid, ‘rubber bullet’, projectiles moving at slow (~60 m/s) speeds. As the technology developed over decades, these projectile systems were standardized in both 37 mm and later 40 mm bore diameters. Originally manufactured with smooth bores, production eventually shifted to standardize on rifled bores, imparting spin to the projectiles in flight. This markedly improved accuracy and decreased accidental impact with high-risk areas of the body. Modern training standards for baton-type projectiles emphasize targeting of the lower abdomen/umbilical region, buttocks, and limbs, particularly the lower limbs, while avoiding head, chest, spine and kidney regions. As effective as modern ERIW systems and training can be, it must be recognized that their deployment in dynamic, policing situations will always include an element of uncontrolled risk and unintended serious injury. ERIW’s can of course be loaded with other than non-flexible, baton projectiles. These include a wide variety of flexible, foam-nose batons, ‘bean bag’/’sock’ rounds and dual-purpose (baton + chemical) rounds intended for use against individuals. Some manufacturers also produce projectiles that can be deployed as an ‘area’ weapon, utilizing OC or CS dispersal. Lastly, it should be noted that ERIW’s can be divided into single-shot or multi-shot launchers, with the ARWEN (an acronym tied to its original UK design heritage) being an example of the latter, designed with a five shot revolving cylinder. The ARWEN remains very popular in Canadian policing at the municipal, provincial and federal levels.

Injury potential and patterns from ERIW’s all derive from the blunt trauma they are designed to inflict. With ideal shot placement, most injuries to large muscle groups will be of a moderate nature, with focal contusions ~5 cm in diameter, extending into surrounding tissues by perhaps as much as 10 cm. It is generally accepted that being impacted by a non-flexible ERIW projectile is similar to being struck by a hardball thrown by a major league pitcher. As such, a strike to a patient’s head could result in a linear/depressed skull fracture, intracranial hemorrhage, loss of consciousness or concussion accompanied by severe contusion, hematoma or laceration. Strikes to the mouth may cause extensive fractures, damage to dentition and an airway threat. Similarly, strikes to the anterior neck may crush airway structures. Posterior neck strikes may fracture and destabilize the cervical spine. A strong index of suspicion for rib fractures should be maintained for any anterior chest impacts. Complaints of dyspnea secondary to such fractures would be expected, and consideration should be given to a closed or tension pneumothorax. Direct impact over the myocardium may cause dysrhythmias, including heart block and ST elevation. Immediate collapse of a patient, with a VF presentation, should prompt consideration for commotio cordis, in the extremely unlikely event the projectile strikes during ventricular repolarization. Impacts on the spine may compromise vertebral integrity. Abdominal impacts over more solid organs such as liver or spleen may result in significant internal hemorrhage and

ruptured bladder should be considered with close-range impacts in the lower midline. Far more commonly, soft tissue injuries such as contusions, hematomas and lacerations will be the only injuries. Depending upon range and body type of the patient, fractures of the long bones may occur and injuries consistent with fracture/dislocation may be seen at joint locations.

Treatment

Treatment is best-focused using a kinematic approach to both seen and suspected trauma, while maintaining a high index of suspicion. Attempt to obtain history regarding the ERIW system and projectile type that was utilized, including engagement distance. For most patients, cold packs for contusions, irrigation and/or dressings for open wounds, splinting for long bones or joints suspected to be unstable will be utilized. C-spine immobilization should be considered for all instances where direct cervical impact of a projectile or a fall onto hard surfaces is known. Mid- and lower-face impacts, as well as direct anterior neck impacts, will likely require aggressive airway management, including the possibility of open (scalpel-finger-bougie) cricothyroidotomy. Careful lung auscultation, cardiac monitoring including 12-lead assessment, along with a heightened awareness for signs of pnemothorax/tension pneumothorax is appropriate for all chest impacts. Monitoring for early shock, supported by serial vital signs at appropriate time intervals, is prudent for all abdominal impacts which occur over at-risk organs.

References:

Advanced EMT-Tactical Course Manual, Uniformed Services University of the Health Sciences / United States Park Police, Counter Narcotics and Terrorism Operational Medical Support (CONTOMS) Program, Bethesda, Maryland, May, 1999.

Police Ordnance Company Inc-ARWEN Less Lethal, "37mm ARWEN® AR-1 Less Lethal Munitions Technical Overview." Markham, Ontario, April, 2016.

Williams, A.G., "British 37mm Baton Rounds." Small Arms Review, Vol. 11, No. 11, 2008.