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Dedicated to the Indomitable Spirit and Sacrifices of the SOF Medic

A Peer-Reviewed Journal that Brings Together the Global Interests of Special Operations’ First Responders
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CONCEPTS AND OBJECTIVES

The series objective is to review various clinical conditions/presentations, including the latest evidence on management, and to dispel common myths. In the process, core knowledge and management principles are enhanced. A clinical case will be presented. Cases will be drawn from real life but phrased in a context that is applicable to the Special Operations Forces (SOF) or tactical emergency medical support (TEMS) environment. Details will be presented in such a way that the reader can follow along and identify how they would manage the case clinically depending on their experience and environment situation. Commentary will be provided by currently serving military medical technicians. The medics and author will draw on their SOF experience to communicate relevant clinical concepts pertinent to different operational environments including SOF and TEMS. Commentary and input from active special operations medical technicians will be part of the feature.

Keywords: Taser; conducted energy weapons

Clinical Presentation

As a tactical paramedic assigned to a law enforcement tactical unit, you have been called out to a scene. A 28-year-old man is holed up in a house. He is screaming incoherently and appears very agitated. He is not known to be armed but is extremely violent and has already assaulted two people. The tactical operations officer plans to try to subdue this individual with less-lethal means. The team has at its disposal the following tools: pepper spray, batons, K-9 units, and conducted electrical weapons (CEWs), also called conducted electrical devices. Because of his unpredictable state and the potential for a prolonged barricade, the team has decided on stand-off deployment of a CEW, followed by rapid physical control of the individual by a three-man arrest team.

As the team makes entry, the suspect charges at the officers with a bat. The first officer deploys a Taser® (Taser International, http://www.taser.com), which hits the suspect in the abdomen and thigh and drops him to the ground. He continues to fight with the arresting officers but, after a few minutes, they are able to handcuff and restrain him, first prone and then on his side. Despite being restrained, the suspect continues to scream, spit, and thrash about. As the medic, the team calls you up to assess the individual to see if he is fit for cells.

This case illustrates how a Taser conducted electrical weapon (CEW) can be an effective control tool for civilian tactical and patrol officers. It also has application for modern military forces conducting low-intensity conflict in complex urban terrain. This utility of a CEW to minimize collateral casualties and maintain fragile coalition relationships has also received recognition.1 The use of a CEW to overcome physical resistance is a significantly advanced force option compared to the historical wooden truncheon or baton. This installment of Clinical Corner will briefly examine Taser technology, its actual and perceived risks, sudden custody death, and some clinical guidance for best outcomes in high-risk circumstances.

Understanding the Taser

To understand the potential for Taser injury, you first need to know that the device may be used in either “drive stun” or “probe” mode. In drive stun mode, the CEW may be deployed without the projectile probe cartridge. Instead, metal contacts positioned on the face of the CEW are “driven” against soft-tissue pressure points of a subject to gain control by means of pain compliance to voice commands. As such, it is far 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 (Figure 1).
In probe mode, two small, aluminum cylinders affixed with barbs (actually, straightened #8 fishhooks custom-manufactured for Taser International) are housed in a replaceable cartridge and propelled by compressed nitrogen at 160 ft/s. Each probe remains tethered to the cartridge by a fine, insulated wire. These probes penetrate the soft tissue or clothing of a subject and discharge what media sources often prominently report as “50,000 Volts!” While correct, Taser’s latest “smart” systems (X26P and X3) deliver an average charge of only 63 microcoulombs or 3.15J (recall, joules = volts × coulombs [J = V × C]), pulsed at 19 times per second. Each trigger press results in a 5-second cycle.2,3 This charge overwhelms a subject’s central nervous system by causing strong, involuntary muscle contractions, using a proprietary technology referred to as neuromuscular incapacitation (NMI). It has the potential for both direct and indirect injuries.

CEW Injuries

Despite the small dimensions and modest velocity of Taser probes, any device that projects objects under dynamic conditions has potential for physical harm. Canadian physician and researcher Christine Hall perhaps asserted it best in a 2009 editorial when she stated, “Tasers, like nuclear weapons, haloperidol, fireworks, and even scissors, can be dangerous in untrained hands.”4

Burn Injuries

The electrical energy of a Taser used in drive stun mode usually results in superficial burns several millimeters in diameter (Figures 2 and 3). It should also be noted that drive stun “signature marks” from actual deployment are often multiple and accompanied by minor abrasions, reflecting their application against a struggling subject.2 These burns require no special treatment aside from basic care and hygiene. They should be observed for the development of any superficial infection.

Penetration Injuries

Probe removal is usually quite simple (Table 1). Rarely does entry cause much more than a small superficial injury, and this can be treated with simple cleaning and appropriate dressings. The resultant injury is generally uncomplicated, unless embedded above the clavicles, in female breasts, or in the genitalia.5,6

Table 1 Steps to Remove Embedded CEW Probes

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td>Ensure wires from probe to cartridge are cut or cartridge is removed from the CEW.</td>
</tr>
<tr>
<td>2.</td>
<td>Use gloves and other personal protective equipment, as appropriate.</td>
</tr>
<tr>
<td>3.</td>
<td>Place thumb and forefinger of the nondominant hand on either side of probe and spread them to tightly tension the skin surrounding the probe.</td>
</tr>
<tr>
<td>4.</td>
<td>Grasp probe firmly with dominant hand and quickly pull (pluck) straight out.</td>
</tr>
<tr>
<td>5.</td>
<td>Inspect probe to ensure it is intact and no fragment has been left in the wound.</td>
</tr>
<tr>
<td>6.</td>
<td>Wipe wound with antiseptic or alcohol pad and apply adhesive dressing.</td>
</tr>
<tr>
<td>7.</td>
<td>Treat probe as a biohazard and contaminated sharp, and dispose of appropriately.</td>
</tr>
</tbody>
</table>

The literature does contain cases of more severe injury, including direct penetrating trauma to the eye and chest. Ng and Chehade describe a 50-year-old man who sustained a wound 1.5cm below the right lower eyelid margin that caused a full-thickness defect. Vitreous was seen to leak when the probe was removed.7 The scleral wound was repaired and cryopexy performed with a satisfactory recovery and visual acuity of 6/9 at 1 week.
postoperatively. Li and Hamill report a catastrophic globe disruption from a Taser probe in a 47-year-old woman with an injury penetrating through the central cornea. The injury resulted in a stellate corneal laceration, which was repaired with a final visual acuity of light perception without projection. In general, any Taser probe injury near the orbits should raise the suspicion of a penetrating ocular injury and removal should be performed in an operating room under general anesthesia, preferably by an ophthalmologist (Figure 4).7

Figure 4 Periorbital penetration of CEW probe

Given the short length of a standard Taser barb, you might think it quite unlikely to penetrate into the pleural cavity, but there is a singular case in which such a mechanism was considered. The patient was a 16-year-old boy of slight build, 5 feet 11 inches tall (180cm), and weighing 145 pounds (66kg), who presented to the emergency department with a probe in the upper left pectoral region. Though mildly tachycardic at 102 beats per minute, he had a room-air oxygen saturation of 98%, no complaint of dyspnea, and physical examination revealed good bilateral breath sounds and absence of subcutaneous air or apparent chest wall trauma. After removal of the probe with local anesthetic and a simple incision, a chest radiograph revealed what the consulting radiologist described as a “small-to moderate-sized” pneumothorax. He underwent a tube thoracostomy and was discharged without further complications after a 2-day stay. Though the authors considered preexisting pneumothorax, accidental violation of the pleura when the probe was dissected, direct trauma either from falling onto the probe (driving it deeper than expected) or impact against a closed glottis (so-called paper bag syndrome), they ultimately questioned whether close range (higher velocity) deployment of the Taser and the patient’s body habitus best explained the pneumothorax.9

Secondary Injuries

Use of these CEWs carries the risk of secondary injury from falls. The basic principle of action is inactivation of neuromuscular tone; therefore, the suspect is almost always going to fall. If this fall is from an elevated position or onto a dangerous surface, secondary injuries can be expected to occur. Both the tactician and clinician need to be aware of this possibility. In addition, sparks from a CEW could ignite flammable liquids or gases (including the alcohol-based carrier agent from early-generation N-chloroacetophenone [CN], o-chlorobenzylidene malononitrile [CS], or oleoresin capsicum [OC; pepper spray] aerosols). If the CEW was used on a patient who was in water, it could result in submersion or drowning.

None of this discussion of CEW injuries is meant to dissuade you from considering the Taser as anything but a valuable control tool, especially when compared to alternatives such as hand-to-hand, batons, and bullets. Rather, it is meant to heighten your level of reflective practice and encourage a high index of suspicion on a case-by-case basis.

Is It Deadly?

Are CEWs deadly? This is a highly contentious issue. Many groups have taken strong stances on either side of this argument. An exhaustive review of this subject is beyond the scope of this article, but it does warrant some exploration.

Some groups strenuously maintain that Taser and NMI technology are torture devices and pose an unsafe risk, directly related to sudden death. The American Civil Liberties Union (ACLU) released a statement in 2005 that at least 148 people had died in the United States and Canada since 1999 after being shocked with Tasers.10 Amnesty International has stated that the number reached 500 in 2012.11 The counter argument maintains that a temporal relationship between the application of a CEW and sudden death does not establish causation. There are elements of these incidents that remain complicated, multifactorial, and not completely understood. The use of a CEW has to be put in the context of what alternative means of physically subduing and arresting the suspect could be used. Irritant gases (e.g., OC), K-9 units, batons, less-lethal rounds, and even hand-to-hand physical restraint all carry the risk of injury or, in some cases, death.

Two systematic reviews recommend that prolonged observation and diagnostic testing are not necessary in patients who are otherwise asymptomatic, not intoxicated, and alert following a CEW exposure.12,13 This provides clinical support to the discharge of the unaltered, physiologically stable patient who has been exposed to an electrical weapon back to police custody without extensive cardiac monitoring and laboratory workup.
In rare instances, fatal arrhythmias have been reported after exposure to an electrical weapon.\textsuperscript{14,11} This is same claim made by ACLU and Amnesty International. The lingering concern is whether electrical weapons can cause cardiac arrhythmias in subjects in the setting of mental disease, intoxicants, hyperadrenergic states, cardiac or pulmonary comorbidities, metabolic abnormalities, and thermoregulatory dysfunction. Suspects in a state of agitation caused by intoxication from cocaine, amphetamines, or phencyclidine often cause themselves to come into contact with police and are exposed to a CEW to facilitate apprehension.

A detailed systematic review of CEWs found no evidence they cause “dangerous laboratory abnormalities, physiologic changes or immediate or delayed cardiac evidence they cause “dangerous laboratory abnormalities, physiologic changes or immediate or delayed cardiac ischemia or arrhythmias”\textsuperscript{12} when exposure lasts 15 seconds or less. Further studies and reviews reached the same conclusion.\textsuperscript{13–16} Further anecdotal evidence against harm is in the hundreds of thousands of training exposures received by police officers over the years. There is no reported injury or death associated in this setting. A study reviewing the use of electrical weapons against minors with a sample size of 100 showed no significant injuries or death.\textsuperscript{17}

Early animal studies, such as that of McDaniels et al.,\textsuperscript{18} found that the safety index for an NMI discharge was significantly and positively associated with weight, but that discharge levels have an extremely low probability of inducing ventricular fibrillation (VF). Attempting to account for the subject bias between “normal” volunteers and the drugged or psychotic individuals common in field applications, researchers tried to document cardiologic and other physiologic changes in resting\textsuperscript{19} and exhausted\textsuperscript{20,21} volunteers. Study of methamphetamine-intoxicated animals was also undertaken.\textsuperscript{22} In all these studies, CEW use was found to be reasonably safe.

As the field use of CEWs continued to grow, the practicality of examining actual deployment outcomes became possible. A prospective, multicenter cohort study\textsuperscript{23} in 2007 (n = 962) found that following CEW use, 99.7% of subjects had no injuries or had minor injuries only. Direct injuries most reported were puncture wounds (83%), contusions (10%), and lacerations (6%). A moderate to severe injury rate was found to be 0.3% and unlikely to be greater than 1%. It included rhabdomyolysis (n = 1), cerebral contusion (n = 1), and epidural hematoma (n = 1). The first of these three cases was judged to have an uncertain relationship to CEW application; the latter two, an indirect relationship, presumably secondary impact injuries from falling.

In response to concern that proximity of probes to the heart and the vector of NMI current might increase risk, Taser International lowered its targeting guideline in September 2009, suggesting to officers that if they were confronting subjects face to face, they should attempt to straddle the beltline with their probe placement. Investigations continued, attempting to establish safe “heart-to-dart” distances and VF thresholds.\textsuperscript{24,25} They concluded that none of these cases, transcardiac or otherwise, produced immediately fatal dysrhythmias and that these data support the overall safety of CEWs. Concern was raised\textsuperscript{18} that multiple 5-second applications might be creating systemic acidotic changes, either respiratory (from altered intercostal and diaphragm movement) or metabolic (from lactic acid associated with extended contraction of large-muscle groups). An expert panel of medical and law enforcement experts, commissioned by the US National Institute of Justice, published a guideline stating that “because the physiologic effects of prolonged or repeated CEW exposure are not fully understood, law enforcement officers should refrain, when possible, from continuous activations of greater than 15 seconds, as few studies have reported on longer time frames.”\textsuperscript{27} Considerable controversy was raised in 2012 when a case series of eight deaths was reviewed in the Journal of the American Heart Association and it was asserted that “ECD stimulation can cause cardiac electrical capture and provoke cardiac arrest due to ventricular tachycardia/ventricular fibrillation.”\textsuperscript{28} Multiple responses\textsuperscript{29–31} to that study were received, refuting interpretation of these data and calling for further research.

In 2013, a summary document titled “The Health Effects of Conducted Energy Weapons” was published.\textsuperscript{32} It is an extensive, well-written and researched document. In it, the expert panel summarizes the issue of in-custody deaths quite succinctly:

\textbf{Sudden in-custody death resulting from a use-of-force event typically involves a complicated scenario that includes \{agitation, physical or chemical restraint, disorientation, stress or exertion, preexisting health conditions, and the use of drugs and alcohol,\} all of which can potentially contribute to a sudden unexpected death. This makes it difficult to isolate the contribution of any single factor. Although the electrical characteristics of CEWs can potentially contribute to sudden in-custody death, \ldots no evidence of a clear causal relationship has been demonstrated by large-scale prospective studies.}\textsuperscript{32}

The authors conclude:

\textbf{If a causal relationship does exist, the likelihood that a CEW will be the sole cause of a sudden in-custody death is low. The extent to which the device would play a role in any death}
is unclear and dependent upon the co-factors involved. Further research is needed to better define these relationships.32

Summary

It is clear that CEWs are an increasingly prevalent law enforcement tool, adopted to address a complex and challenging problem. The potential for serious injury from a single deployment of a CEW is extremely low. The debate regarding the link between these electrical weapons and sudden in-custody death is likely to continue because their use is often in complex and volatile situations. Any consideration of injuries has to be put into that context. One must also consider what injuries to a subject would result if an alternative force method was used. Furthermore, the potential benefits of CEWs, including reduction in injuries to the public and law enforcement officers, need to be considered.

Disclaimer

The views and medical opinion herein represent those of the authors. They do not reflect the operation practice or views of the Canadian Forces or other organizations. The cases are provided to be educational and thought provoking; at no time does the author suggest that the tactical clinicians exceed the scope of their practice or act against the direction of their medical protocols or recommendations of their medical leadership.

References


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