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Study of Deaths Following Electro Muscular Disruption: Interim Report

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JUN. 08

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NCJ 222981



David W. Hagy

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ACKNOWLEDGMENTS

The National Institute of Justice gratefully acknowledges the following individuals. Their information, insight and knowledge benefited the development of this Interim Report.

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BACKGROUND

During the three years from 2003 through 2005, 47 states and the District of Columbia reported 1,095 arrest-related deaths proximal to law enforcement's use of force. For many years police leaders have sought alternatives to lethal force and better methods to subdue individuals to limit injuries and death. Less-lethal technologies have been used in law enforcement for this purpose extensively since the early 1990s. In recent years, electro-muscular-disruption (EMD) technology, also known as conducted energy devices (CEDs), have become the less-lethal weapon of choice for a growing number of law enforcement agencies. CED uses a high-voltage, low-power charge of electricity to induce involuntary muscle contractions that cause temporary incapacitation.

Industry reports suggest some 11,500 law enforcement agencies have acquired CEDs. Approximately 260,000 EMD devices are deployed in the operational environments of law enforcement agencies. Studies undertaken by law enforcement agencies deploying CED indicate reduced injuries to officers and suspects resulting from use of force encounters and reduced use of deadly force. However, a significant number of individuals have died after exposure to a CED. Some were normal healthy adults; others were chemically dependent or had heart disease or mental illness.

The leading manufacturer of CEDs is TASER® International of Scottsdale, Ariz. In 2003 TASER International introduced the TASER X26®. The X26 model is the prevailing conducted energy device being acquired by law enforcement today. Other CEDs have been used in incidents in which a death occurred, including the TASER M26®, other stun guns and shields.

These deaths have given rise to questions from law enforcement and the public regarding the safety of CEDs. Because many gaps remain in the body of knowledge with respect to the effects of CEDs, the National Institute of Justice (NIJ), the research, development and evaluation agency of the U.S. Department of Justice, has undertaken a study, *Deaths Following Electro Muscular Disruption*, to address whether CEDs can contribute to or cause mortality and if so, in what ways.

STUDY METHODOLOGY

The study is directed by a steering group with representation from NIJ, the American College of Pathologists, the Centers for Disease Control and Prevention, and the National Association of Medical Examiners. To support the study, the steering group appointed a medical panel composed of physicians, medical examiners, and other relevant specialists in cardiology, emergency medicine, epidemiology, pathology and toxicology.

In formulating the interim findings reported here, the panel conducted mortality reviews of CED-related deaths and reviewed the current state of medical research relative to the effects of CED. Mortality reviews have included analysis of autopsy and toxicology results, findings from the scene investigation, post-exposure symptomatology, post-event medical care, and the extent of natural disease presented in a decedent, if any. This report contains recommendations concerning death investigation arising from the mortality reviews conducted by the panel and a review of currently available research. The panel examined the currently recognized causes of sudden deaths, chiefly physical, cardiac, pulmonary, metabolic and thermoregulatory mechanisms. The medical panel has also consulted stakeholders such as human rights groups, law enforcement professionals, research scientists and manufacturers of CEDs.

Many aspects of the safety of CED technology are not well-known, especially with respect to its effects when used on populations other than normal healthy adults (i.e., at-risk individuals). A significant number of relevant studies are now under way, including studies involving healthy adults, animals and field exposures during actual use-of-force incidents. Additional research is needed to improve the understanding of how CEDs function, their effect on at-risk individuals, complicating medical conditions and related aspects of CED exposure. This report provides a consensus view of the panel members from a complete review of the available, peer-reviewed research literature and extensive information concerning the use of CEDs in the field. The findings have been limited to those conclusions that can be reached based on current understanding. The panel will continue to examine new research and case studies of deaths proximate to the use of CED.

FINDINGS

Although exposure to CED is not risk free, there is no conclusive medical evidence within the state of current research that indicates a high risk of serious injury or death from the direct effects of CED exposure. Field experience with CED use indicates that exposure is safe in the vast majority of cases. Therefore, law enforcement need not refrain from deploying CEDs, provided the devices are used in accordance with accepted national guidelines. (For example: *Electronic Control Weapons*, a model policy of the International Association of Chiefs of Police.)

The potential for moderate or severe injury related to CED exposure is low. However, darts may cause puncture wounds or burns. Puncture wounds to an eye by a barbed dart could lead to a loss of vision in the affected eye. Head injuries or fractures resulting from falls due to muscle incapacitation may occur.

CEDs can produce secondary or indirect effects that may result in death. Examples include deploying a device against a person who is in water, resulting in drowning, or against a person on a steep slope resulting in a fall, or ignition risk resulting from deployment near flammable materials such as gasoline, explosives or flammable pepper spray that may be ignited by a spark from a device.

There is currently no medical evidence that CEDs pose a significant risk for induced cardiac dysrhythmia when deployed reasonably. Research suggests that factors such as thin stature and dart placement in the chest may lower the safety margin for cardiac dysrhythmia. There is no medical evidence to suggest that exposure to a CED produces sufficient metabolic or physiologic effects to produce abnormal cardiac rhythms in normal, healthy adults.

Research shows that human subjects maintain the ability to breathe during exposure to CED. Although there is evidence of hyperventilation in human subjects immediately following CED exposure, there is no medical evidence of lasting changes in respiratory function in human subjects following exposure to CED.

CED technology may be a contributor to “stress” when stress is an issue related to cause of death determination. All aspects of an altercation (including verbal altercation, physical struggle or physical restraint) constitute stress that may represent a heightened risk in individuals who have pre-existing cardiac or other significant disease. Current medical research suggests that CED deployment is not a stress of a magnitude that separates it from the other components of subdual.

Excited delirium is one of several terms that describe a syndrome characterized by psychosis and agitation and may be caused by several underlying conditions. It is frequently associated with combativeness and elevated body temperature. In some of these cases, the individual is medically unstable and in a rapidly declining state that has a high risk of mortality in the short term even with medical intervention or in the absence of CED deployment or other types of subdual.

Excited delirium that requires subdual carries with it a high risk of death, regardless of the method of subdual. Current human research suggests that the use of CED is not a life-threatening stressor in cases of excited delirium beyond the generalized stress of the underlying condition or appropriate subdual.

FINDINGS

In many cases of excited delirium, high body temperature is the primary mechanism of death. There is no medical evidence that exposure to CED has an effect on body temperature.

The purported safety margins of CED deployment on normal healthy adults may not be applicable in small children, those with diseased hearts, the elderly, those who are pregnant and other at-risk individuals. The effects of CED exposure in these populations are not clearly understood and more data are needed. The use of a CED against these populations (when recognized) should be avoided but may be necessary if the situation excludes other reasonable options.

Studies examining the effects of extended exposure in humans to CED are very limited. Preliminary review of deaths following CED exposure indicates that many are associated with continuous or repeated discharge of the CED. The repeated or continuous exposure of CED to an actively resisting individual may not achieve compliance, especially when the individual may be under drug intoxication or in a state of excited delirium. The medical risks of repeated or continuous CED exposure are unknown and the role of CEDs in causing death is unclear in these cases. There may be circumstances in which repeated or continuous exposure is required but law enforcement should be aware that the associated risks are unknown. Therefore, caution is urged in using multiple activations of CED as a means to accomplish subdual.

All CED use should conform to agency policies. The decision to use a CED or another force option is best left to the tactical judgment of trained law enforcement at the scene.

POST-EVENT MEDICAL CARE

Medical evaluation is not mandatory after all CED exposures. Individuals who have been exposed to CEDs may suffer injuries. Appropriate medical care should be provided if this is suspected, especially when probes penetrate vulnerable areas of the head, face, neck, genitals, or female breast regions or in cases of injury from falls, burns or other trauma. In most cases, probes embedded in the skin may be removed by properly trained medical or law enforcement personnel in accordance with local protocols. Medical care should be provided when probes are located in the vulnerable areas noted above or if there is concern for underlying injuries.

Underlying medical conditions may be responsible for behavior that requires subdual by law enforcement, including the use of CEDs. Abnormal mental status in a combative or resistive subject may be associated with a risk for sudden death. This should be treated as a medical emergency. In these cases, medical providers are encouraged to assess body temperature and obtain and retain blood samples and an electrocardiogram as early as possible. If needed, cooling, sedation and hydration should be provided as soon as possible. Emergency medical services protocols specifying these interventions may be useful.

Sudden lack of responsiveness may occur at any time and may indicate a medical crisis. Therefore, individuals should be monitored for changes in condition. Those reporting illness or suspected of having significant medical or psychiatric conditions should be provided with appropriate medical care.

Darts and clothing removed during medical care should be retained for investigative purposes and handled as evidence. When removing embedded darts, care should be taken to avoid exposure to bloodborne pathogens. Detailed records of treatment should be maintained.

CONSIDERATIONS IN DEATH INVESTIGATION

When a death occurs following deployment of a CED by law enforcement personnel who are subduing, restraining or apprehending a subject, the death will be investigated by the appropriate medical examiner's or coroner's office as an in-custody death. Because deaths following CED deployment involve somewhat typical scenarios and complex and predictable issues, the death investigation needs to include consideration of information that may not be gathered in a routine death investigation or in a typical in-custody death investigation. It is not the intent of this Interim Report to provide a comprehensive checklist of tasks that should be performed. Rather, the most crucial areas of helpful information are outlined below.

The information needed for investigation of death following CED use will need to be collected by death investigators from multiple sources and in consultation with the medical examiner or coroner who has ultimate responsibility for the case. Further, the forensic pathologist who performs the autopsy will need to be provided such information for review. Information obtained from the autopsy examination may trigger or require additional investigation. The forensic pathologist who performs the autopsy is an integral part of the investigative team.

The following information can be useful in establishing facts and should be considered during the death investigation:

- a. A timeline of all events with attempts to verify, to the extent possible, the accuracy of the dates and times of reported events, with specific emphasis on the interval between CED use, unresponsiveness, and death.
- b. Clarification as to whether the CED was used in drive stun and/or cartridge mode(s).
- c. Recent activities of the subject prior to the incident.
- d. The emotional state of the subject.
- e. The subject's medical conditions determined by medical history taking, medical record review and medical conditions determined at autopsy.
- f. The subject's drug use history including both prescription and illicit drugs as well as alcohol.
- g. Specific inquiry into the subject's cardiac history including review of any electrocardiograms or other cardiac function or laboratory tests that have been performed in the past.
- h. Specific inquiry to the subject's seizure history to rule out history of seizures or to clarify the nature of a past seizure disorder.
- i. Review of witness accounts, police reports, use of force reports, emergency medical services records, medical and psychiatric records, and any videos, photographs or digital images of the events.
- j. When possible, darts should not be removed from the decedent's body or clothing
- k. Measure and document body and ambient temperature taken at the scene and other locations such as the hospital.
- l. If death occurs after arrival at a hospital, obtain blood drawn upon arrival at the hospital so it may be tested for intoxicants, if needed.
- m. Review information downloaded from the CED with special emphasis on number and duration of discharges over the time interval involved.
- n. Investigate the subject's place of residence and recent activities to determine if additional medical history or evidence of drug use exists. This may require the coordination of the medical examiner/coroner with law enforcement.

CONSIDERATIONS IN DEATH INVESTIGATION

Assuming that the investigation and autopsy are performed and documented/reported in accordance with NIJ's *Guide for the Death Scene Investigator* and the National Association of Medical Examiners' *Forensic Autopsy Performance Standards*, additional information and procedures that may be helpful are:

- a. Performance of a complete autopsy of the scope usually performed for deaths in custody.
- b. Comprehensive postmortem toxicology, specifically including tests for alcohol, nervous system stimulants, common drugs of abuse, anti-seizure drugs, and therapeutic drugs often prescribed for psychiatric disorders.
- c. Measurement of the thickness of the anterior chest wall from the skin to the rear of the pre-pericardial sternum at intercostal space between the left fourth and fifth ribs.
- d. Measurement of the thickness of clothing in the area(s) where CED darts or prongs were applied.
- e. Documentation of the CED dart's barb length(s).
- f. Consideration of unusual or atypical current flow paths, such as body to ground, body to water, body to metal, etc.
- g. Determination of the nature of any other forms of subdual or restraint that were employed in the case in question.
- h. Utilization of appropriate consultants such as cardiologists, cardiac pathologists, and neuropathologists as needed.

The medical examiner's or coroner's office conducting the death investigation will ultimately be responsible for certifying the cause and manner of death. This Interim Report does not include guidelines for such certifications.

GLOSSARY OF TERMS

Cardiac Mechanisms

The ways the heart can fail when injured or sick.

Conducted Energy Device (CED)

A weapon primarily designed to disrupt a subject's central nervous system by means of deploying electrical energy sufficient to cause uncontrolled muscle contractions and override an individual's voluntary motor responses.

Darts

Projectiles that are fired from a CED and penetrate the skin; wires are attached to the probes leading back to the CED.

Dart (Barb) Removal

The act of removing a probe from a person's body or clothing.

Deployment

Sending CED devices into the field with law enforcement officers.

Duration

The aggregate period of time that CED shocks are activated.

Dysrhythmia

Any disturbance or irregularity of the heartbeat.

Electrocardiogram

A graphic produced by an electrocardiograph, which records the electrical activity of the heart over time.

Electro Muscular Disruption

Effect CED has on the body. Overrides the brain's communication with the body and prevents voluntary control over the muscles.

Excited Delirium

State of extreme mental and physiological excitement, characterized by extreme agitation, hyperthermia, euphoria, hostility, exceptional strength and endurance without fatigue.

Hyperventilation

Breathing faster and/or deeper than normal, thereby reducing the amount of carbon dioxide, or CO₂, in the blood to below normal.

Less Lethal

A concept of planning and force application that meets an operational or tactical objective, with less potential for causing death or serious injury than conventional, more lethal police tactics.

Less-Lethal Weapon

Any apprehension or restraint device that, when used as designed and intended, has less potential for causing death or serious injury than conventional police lethal weapons.

Metabolic Mechanisms

The ways the metabolism can fail when injured or sick.

Physical Mechanisms

The way in which illness or injury can compromise heart/lung function or put body metabolism at risk.

Pulmonary Mechanisms

The way in which lung function can be compromised by injury or sickness.

Respiratory

Relating to the act or process of inhaling (breathing in) and exhaling (breathing out); breathing, also called ventilation.

Restrain

To control, limit, or prevent movement.

Restraint

A device that restricts movement.

Sensitive Areas

A person's head, neck, and genital area, and a female's breast areas.

Standard CED Cycle

A 5-second electrical discharge occurring when a CED trigger is pressed and released. The standard 5-second cycle may be shortened by turning the CED off. (Note: If a CED trigger is pressed and held beyond 5 seconds, the CED will continue to deliver an electrical discharge until the trigger is released.)

Subdual

To bring under control.

Symptomatology

The combined symptoms of a disease: the symptom complex of a disease.

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3. Develop affordable and effective tools and technologies to enhance the administration of justice and public safety.

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4. Disseminate relevant knowledge and information to practitioners and policymakers in an understandable, timely, and concise manner.
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