

Sudden Death, “Excited” Delirium, and Issues of Force:

Part II – Electronic Control Devices

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Part II focuses on scientific information about sudden death and electronic control devices (ECDs), such as the TASER^{®1} brand of products, and other handheld stun gun weaponry.

For purposes of this article, electronic control devices (ECDs) are defined as those electronic devices which use propelled wires or direct contact (or in sufficiently close proximity to transfer an electrical charge) to conduct energy to affect sensory and motor functions of both the sensory and/or motor nervous systems of the exposed person.

ECDs which affect the sensory functions of the peripheral nervous system include, but are not limited to, handheld stun guns, electronic shields, the original Air TASER, and similar devices. Currently available ECDs which affect sensory and motor functions of both the sensory and motor aspects of the peripheral

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nervous system (causing neuromuscular incapacitation (NMI) include ECDs which use propelled wires with barbs to temporarily capture a person at a distance or via three point and drive/stun combinations are exclusively limited to those devices manufactured by TASER International, Inc. in Scottsdale, AZ. While other manufacturers may have similar devices in design and/or production, the TASER M26 and X26 models of electronic control devices, both manufactured by TASER International, Inc., are the only ones currently in wide use by law enforcement agencies around the globe, and also have had extensive domestic and international scientific testing conducted on their safety, efficacy, and risk utility.

Also, the TASER XREP (eXtended Range Electro-muscular Projectile), a wireless projectile with a range up to 30 meters which contains a fully operational TASER circuit payload, packaged in a nonlethal 12-gauge shotgun round, is expected to be available in 2007.

Past and Present

ECDs are weapons and are not toys. Their four plus decades of history includes several products, including, but not limited to, THE SOURCE flashlight, the TALON Glove, NOVA[®] XR-5000 and NOVA Spirit stun gun, NOVA Capture Shield, ULTRON II[®] stun gun, original TASERTron, AIR TASER, Advanced TASER M26, TASER X26, and STINGER[®]. Intended to temporarily incapacitate the targeted individual through sensory overload and/or neuromuscular incapacitation, they may cause injury to the individual. For example, placing the spark gap area of a handheld stun gun (e.g., NOVA, ULTRON II) across the bridge of an individual's nose may cause injury to the eyes when the unit is fired. Likewise, applying an ECD (e.g., TASER-brand device or Stinger-brand device) to someone standing on the edge of a high cliff may cause the person to fall off it, potentially causing injury to the person. Also, the resulting muscle contractions associated with an ECD application

may, in some circumstances, result in (or contribute to) exertion or sports-type injuries. To minimize these potential injuries, it is imperative that users be trained by qualified ECD instructors. However, even the best training will not prevent injury when the training is ignored, when poor judgment is used by the ECD user, or in some unforeseen or unexpected circumstances or individual susceptibilities. The issue of minor injury is secondary to sudden death issues.

Sudden Death, Instantaneous Death, and In-Custody Death

Before discussing several myths surrounding ECDs, here is a very brief review of key definitions which were discussed in more detail in Part I of this series. Recall that the World Health Organization defines *sudden death* as cardiorespiratory collapse occurring within 24 hours of the beginning of symptoms. In contrast, *instantaneous death* has been defined by several authorities as death which occurs within five minutes of the onset of symptoms. Krosch, Binker, and Blackburne (1992) defined a *sudden in-custody death* as “Any **unintentional** death that occurs while a subject is in police custody [emphasis added]” (p.5).

Although handheld stun devices have been used for several decades, in the past, there were never the nonscientific allegations that they caused a sudden in-custody death, as many people and groups are asserting with the TASER-brand of ECDs. There have been many allegations that these devices have caused (or directly contributed to) a sudden death or a sudden in-custody death. Upon in-depth review of the facts and circumstances surrounding these events (including depositions and/or trials) to date, it has been clearly demonstrated that these devices have not caused any person’s death. Often these sensationalized allegations have given rise to the development of numerous myths, some the size of urban legends, surrounding ECDs.

The following 12 well-known and publicized myths surrounding ECDs will be discussed. Space does not permit a more exhaustive review of myths. The focus is on whether the use of ECDs can cause sudden death or sudden in-custody deaths. Remember that, when a free person is seized for purposes of the Fourth Amendment, if (s)he dies in the process of or after being seized, technically, this is one form of sudden in-custody death. Similarly, if an ECD is used on a person who is incarcerated and then dies, this fits the traditional definition of an in-custody death.

Myths Versus Scientific Facts

Myth #1: *ECDs cause a person’s heart to stop beating; thereby, causing death.*

Scientific Fact: The ECDs which have been independently tested by medical research groups and professionals, to date, all scientific data indicate these tested ECDs will not cause the heart to go into dysrhythmia; thereby, causing death.

Limited electrical heart testing was done on THE SOURCE flashlight in 1978 and found that “the device did not alter the electrical activity of the heart” (Gorelick, 1978, p.1). According to information originally provided by the manufacturer, the output voltage of THE SOURCE is seven kilovolts and has an output current of 500 microamperes, both too low to affect the heart’s function.

The NOVA XR-5000 handheld stun device also was scientifically tested to ascertain if it would interfere with the rhythm of the heart. Two studies (1985), one conducted by Robert Stratbucker, M.D., Ph.D., the other by Theodore Bernstein, Ph.D., found the device to be safe for intended use on humans. Scientific research revealed the NOVA XR-5000 had output between 47,000 and 50,000 volts, with .00006 amperes without resistance, .00004

amperes with resistance, and 0.35 joules (watts per second). The tested units produced 22-24 pulses per second (PPS) (Kaufman, 1987, p.37).

The TASER-brand of ECDs have also been scientifically tested and shown not to cause ventricular fibrillation (VF). McDaniel, Stratbucker, Nerheim, and Brewer (2005) noted that, “There has been no report directly related to [TASER devices] inducing ventricular fibrillation (VF), although preliminary findings suggest that the likelihood of inducing VF by a neuromuscular incapacitation device is extremely low” (p. S284).

The TASER M26 has 50,000 (peak open circuit arcing voltage, with 5,000 peak loaded voltage) volts (V), 3.6 milliamperes (mA) (or .0036 amperes [A]), with an energy pulse of 1.76 joules (J) (nominal at peak capacitor, and 0.5 J delivered into load). The TASER X26 has 50,000 V (peak open circuit arcing voltage with 1,200 peak loaded voltage), 2.1 mA (or .0021 A), with an energy per pulse of 0.36 J (nominal or peak capacitor, and 0.07 J delivered into load). In contrast, external cardiac defibrillators typically generate approximately 400 J, which further illustrates the safety of TASER-brand devices with regard to the human heart (Gibault, 2006, p. 2). To see one’s hair stand up, many people have placed a hand on a Van de Graaff generator which can generate up to one million volts. You may recall seeing these devices at carnivals or science exhibits.

Other scientific studies which support the safety of TASER-brand ECDs include, but are not limited to, Maier, Nance, Price, Sherry, Reilly, Klauenberg, and Drummond, 2005; Orange County (FL) Sheriff’s Office, 2004; British Columbia Office of the Police Complaint Commissioner, 2004; Bleetman and Steyn, 2003; United Kingdom Defence Scientific Advisory Council, 2002; Stratbucker, Roeder, and Nerheim, 2005; Biomedical Engineering, 2004 (TASER X26); Biomedical Engineering, 2003 (TASER M26); Ho, Miner, Heegaard, & Reardon, (2006). These studies are in addition to the numerous medical and electrical engineering publications on similar electrical outputs and products or much higher output systems, products, and/or injuries.

Regarding other ECDs, no such extensive scientific studies have been found in the literature which evaluates their safety, effectiveness, or risk utility.

Myth #2: *ECDs affect pacemakers which can lead to sudden death.*

Scientific Fact: According to Mark Kroll, Ph.D., FACC, one of the world’s leading experts on electricity and pacemakers, the answer is “no.” Dr. Kroll notes a pacemaker is required to take much stronger shocks from external defibrillators by the *Active Implantable Medical Device* requirements 90/365/SEC. He further notes that “the 360 J external defibrillator has 1000 times more energy per pulse than does the TASER X26” (Kroll, 2006, p. 7).

Myth #3: *If two ECDs are used on a person at the same time, and each ECD has 50,000 volts, doesn’t the person receive 100,000 volts?*

Scientific Fact: No. First, a TASER X26 only delivers 1,200 V into the load, not 50,000 peak open circuit arcing voltage. Also, electricity is not cumulative, so one cannot add 1,200 V plus 1,200 V and arrive at 2,400 V being applied to the person. What is true is that the individual is receiving two simultaneous applications of 1,200 V (at .0021 A and 0.07 J per pulse).

Myth #4: *When a person is touched by an ECD which has “50,000” volts, then (s)he is receiving an enormous amount of energy.*

Scientific Fact: No. This myth, in part, stems from *electricaphobia* (unreasonable fear of electricity) from childhood. The mind tells us that if a 120V wall outlet is “bad,” then “50,000” V must really be bad!! The voltage in and of itself is not the primary determinant of potential injury.

According to Dr. Mark Kroll, an individual exposed to a TASER device receives a very small amount of energy delivered into the body. Consider, a TASER X26 is powered by two, three volt camera batteries. The 50,000 volts is the peak open circuit arcing voltage to get electricity through the clothing. The voltage delivered into the person from, say, a TASER X26 is 1,200 V. It gives 19 (very short duration) pulses per second. Dr. Kroll notes that the current is ZERO 99.8% of the time. Or, to put it another way, one TASER X26 pulse is “on” for only 1/25,000ths of a second, times 19 PPS equals 19/25,000ths of a second. Given the average current is about .0021 A, the average voltage is about **2/3 of one volt**, less than a AA penlight battery (Kroll, 2006, pp. 5-6).

Myth #5: *ECDs affect the breathing of a person when they are applied and can cause a sudden death.*

Scientific Fact: Current human/subject research indicates that a person’s breathing during TASER device exposure is actually increased. When a fellow officer has an ECD applied to him (or her) during training, (s)he usually is talking, breathing, etc., including the usual profane expletives describing his or her discomforting experience.

Myth #6: *ECDs directly affect the central nervous system of the human body.*

Scientific Fact: Even though this statement is contained in the sample policy by the International Association of Chiefs of Police (IACP), this is incorrect. ECDs cannot directly affect the central nervous system of the human body, but do affect the peripheral nervous system – sensory and motor nervous systems of the human body. While certain drugs can directly affect the central nervous system of the body, ECDs are unable to do it.

Myth #7: *If the person is standing in water or is wet, an ECD can cause electrocution.*

Scientific Fact: No. While some people argue this is “common sense,” scientific tests indicate that the individual will not be electrocuted, thus causing a sudden death. These tests were conducted with the NOVA XR-5000, and with other ECDs as well. While the ECD will not cause electrocution, the individual may be temporarily incapacitated, unable to support him or herself, and unable to swim, which could lead to drowning.

ECDs which have been scientifically tested do not cause electrocution, whether the individual is standing in water or standing on dry ground.

Myth #8: *ECDs can cause burns which can lead to sudden death.*

Scientific Fact: When used in a drive stun (or touch stun) mode (without the barbs), handheld stun devices, such as the NOVA XR-5000, NOVA Spirit, ULTRON II, and TASER-brand devices, usually do cause *friction abrasions*, or low-grade burns. These are usually harmless, unless the individual picks at any scab which may form which can cause an infection. *Friction abrasions* will not cause a sudden death.

Myth #9: *The heart of a person who has cocaine in his (or her) system is more likely to go into ventricular fibrillation when shocked with an ECD which leads to sudden death.*

Scientific Fact: While medical studies do confirm that cocaine does stimulate the heart to beat faster, scientific studies have

also found that cocaine actually reduces the heart’s sensitivity to electrocution. According to Dr. Mark Kroll, animal studies show that it takes 51% *more* current to fibrillate the heart with cocaine present (Kroll, 2006, p. 7. See also Tinsdale, Shimoyama, Sabbah, & Webb, 1996a; Tinsdale, Ducharme, Shimoyama, Webb, Sabbah, & Edwards, 1996b). To date, there is no scientific or medical evidence that links any ECD to ventricular fibrillation.

Myth 10: *Using an ECD on a person who has been sprayed with an alcohol-based pepper spray or who has flammable liquids on his (or her) clothing or body may cause a fire, resulting in a sudden death.*

Scientific Fact: Yes, injury from ignited materials can occur and have occurred. There is at least one written account when an individual who had flammable liquid on his body died after coming into contact with an ECD; this is a very rare event. It is true that an ECD may ignite flammable vapors causing a fire which could lead to a person’s death. There have been several studies which have identified flammable vapors and liquids, such as alcohol and gasoline, may ignite when coming into contact with the spark of the ECD.

Myth #11: *When a person dies after an ECD is used on him (or her), doesn’t this show that the ECD caused his (or her) death?*

Scientific Fact: To date, this “cause and effect” relationship has not been shown. While it is true that the person may have died after having an ECD applied to him (or her), this *temporal usage* does not show cause and effect. After all, one could also cite the individual ate breakfast and/or lunch before dying, and these items were also *temporal* to his or her death. Many people (often those opposed to ECDs) confuse “cause and effect” with “correlation.”

Correlation is never “cause and effect.” Correlation shows the strength of relationship between two or more variables (e.g., vehicle speed, fatal accident, etc.), but does not show cause and effect. A “cause and effect” study must be done to show that A caused B. Many people and/or groups opposed to the use of ECDs often cite the *temporal use* of an ECD prior to an individual’s death as *proof* that the ECD caused the death, but this is an unscientific linking of two events which no one has yet proven are related.

While there is a temporal dimension to causality, because A preceded B does not mean that A caused B. The analyst of causality must assess whether there is any “cause and effect” which can be ruled out when comparing and interpreting the causal inference. Cook and Campbell (1979) note that causal inference depended upon three factors: First, “the cause has to precede the effect in time; second, the cause and effect have to be related; and third, other explanations of the cause/effect relationship have to be eliminated” (p. 18).

Lyons (2000) writes that causality, acknowledging Miles and Huberman (1994), “can be *inferred* by examining *observed* associations between two or more events or variables, if there is:

- Strength of association (much more B with A than with other possible causes);
- Consistency (A is found with B by many studies in different places);
- Specificity (a particular link is shown between A and B);
- Temporality (A before B, not the reverse);
- Biological gradient (if more A, then more B);
- Plausibility (a known mechanism exists to link A and B);
- Coherence (A-B relationship fits with what else we know about A and B);
- Experiment (change A, observe what happens to B); and

• Analogy (A and B resemble the well established pattern noted in C and D) (p. 146).

As previously discussed, there have been no scientific studies which demonstrate or link the use of ECDs to sudden death. Actually, most studies which have examined the issue have found the opposite. At best, therefore, only correlation can be established, not cause and effect.

Keep these facts in mind when you read about an ECD being used on a person who then dies. All too often those with limited knowledge or those who do not fully understand that “correlation” does not equal “cause and effect” will accept *implied causality* which is not based on scientific study or evidence. Evidence such as hair samples, toxicology screening, neurochemistry testing coupled with the medical examiner’s knowledge about electricity and his (or her) excluding other causes of death, must be examined to provide rigorous scientific support for a cause of death.

Myth #12: *All scientific studies about electricity and its affects on the human body were funded by manufacturers of products, including ECDs.*

Scientific Fact: When one considers the number of scientific studies which examine electricity, and electricity and its effect on the human body, the literature surfaces that product manufacturers have had little impact on such testing. While a few manufacturers may have helped fund seminal research into a specific area, national grants and other sources have been the primary vehicles for conducting such research.

It must also be remembered that scientific testing using human subjects has high hurdles which must be cleared prior to the conduct of such research. Many times, ECD research has not been conducted on human subjects because an internal review board (IRB) has failed to approve such research. In other cases, the IRB has permitted limited testing. (This is virtually no different than prescription drug testing on human subjects, usually after potential safety concerns have been addressed to the satisfaction of the IRB members.) In most every case, government funding has underwritten major ECD research.

Summary

There is a lot more which can be discussed about ECDs, but the purpose of Part II is only to focus on ECDs and sudden death. If you desire to obtain more information about ECDs, or a specific ECD, it is recommended that you contact the manufacturer of the ECD device in which you are interested. You can generally access their address, telephone number, and/or Web address by conducting a Google™ search, or by pulling the *Police and Security News Buyer’s Information Guide* (March/April 2006) issue off your bookcase shelf.

Part III, appearing in the July/August 2006 issue of this publication, will identify and discuss behavioral cues of individuals who are at high risk for sudden death, contemporary medical theories about sudden death, and encounter guidelines.

Note: *This is the second of a five part series about sudden death, “excited” delirium, and jail suicide. In a pioneering, progressive, and cooperative educational venture with Police and Security News and the Institute for the Prevention of In-Custody Deaths, Inc. (IPICD), readers may receive their Basic Certification in this subject after reading Parts I, II, and III; watching two short video vignettes; and completing a short case study via the IPICD Web site (www.ipicd.com or www. incustodydeath.com). Readers who are interested in obtaining Basic Certification in this subject, or administrators who are interested in training their employees via*

this hybrid educational approach, are urged to E-mail David Berman at staff@ipicd.com for enrollment information. 

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