THE STATE OF CURRENT HUMAN RESEARCH AND ELECTRONIC CONTROL DEVICES (ECDs)

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Introduction

Electronic Control Devices (ECDs) are becoming increasingly popular means for controlling violent or resisting subjects. They are being used for military, law enforcement and personal defense applications. ECDs have come under scrutiny in recent years because of the occasional death of a subject that occurs following the ECD application to this person.

These types of sudden deaths (SDs) have primarily occurred in subjects with similar risk profiles. SDs have primarily been attributed to drug intoxication, underlying cardiac disease, mental illness or the syndrome of extreme agitation often known as excited delirium. These attributes are independent of ECD use. Despite this, a possible causal relationship between SD and ECD use is sometimes questioned.

Because of this, research has been increasingly performed in the area of ECD use and the physiologic effects of these devices on humans have been examined. This report will address some of the most pertinent human research in this area and will discuss the implications of this research on the phenomenon of SD.

The predominant manufacturer of ECD technology from a global standpoint is TASER International (Scottsdale, Arizona, USA). The most popular ECD in use today is the TASER X26®. Unless otherwise stated, this will be the ECD used as the basis for the research presented.

The Sudden Custodial Death Phenomenon

To understand the SD phenomena in its true context, it is important to realize that sudden, custodial deaths have been occurring for many years. The earliest literary description of SDs appears in a paper by Dr. Luther Bell in 1849.[1] This paper describes deaths of persons in state custody for mental illness and the observed descriptions of their deaths are eerily similar to the SD events of modern day. The difference is that Dr. Bell observed these within the confines of an insane asylum instead of on the street in the presence of the police. The events by Dr. Bell were recorded some 150 years before the advent of the modern day TASER device.

In order to understand the SD phenomenon more accurately, it is important for one to know the magnitude of this problem. There has been a recent surveillance study of the SD phenomenon which has been presented in a scientific forum and is currently under peer-review for publication.[2] This study has helped to define the factors associated with SD including with what frequency ECDs are associated with SD events. Additional, indirect information from this surveillance was the first clue that ECDs not only do not have a reliable association with SD events but that any SD event occurring after ECD application is extremely unlikely to be caused by electrocution since this project demonstrated that collapse after ECD application was never instantaneous.

ECDs receive criticism most often when associated with a SD situation. These events are alarming and tragic to society. When they occur, society tends to look for someone or something to squarely place blame. Although the vast majority of SDs are found at autopsy to be caused by things such as illicit drug overdose or underlying heart disease, it is not satisfying for society to place this blame on these issues since that is the equivalent of blaming the deceased for their own death. Instead, people tend to look for factors that don't involve the decedent's lifestyle or genetics. Because of this, it is very easy to look to blame other people (such as law enforcement personnel) for poor tactics or training or to blame inanimate objects or tools used in the custodial process (such as pepper spray, restraint devices and ECDs).

We have seen this phenomenon occur in history as new tools or tactics emerge in law enforcement. Pepper spray is an excellent example. It was introduced in the American civilian law enforcement sector in the 1980's as a chemical irritant capable of producing compliance from painful stimulus. As a result, civil rights groups launched campaigns to prevent or restrict its use claiming that it was dangerous and potentially lethal.[3] In this cited report, it was estimated that 1 in 600 pepper spray exposures resulted in death. Manufacturers and users of pepper spray underwent a period of fairly intense litigation. Eventually, studies were completed that

showed these claims to be without merit.[4 5] Following the controversy and eventual studies, pepper spray is now widely accepted as a useful law enforcement tool and is carried by police officers without hesitation. Pepper spray has also reached the point where it is sold on the general consumer market without reservation. ECDs appear to be in a similar period of scrutiny due to their relative newness.

Lastly, because ECDs represent fairly new technology, they make an easy target for litigation. Litigation in this area is often based on the perceived "unknowns" of new technology. This is especially true for ECDs because they represent technology based on electrical principles that laypeople find confusing. In America, this is coupled with a culture that tends to embrace litigation that involves potentially huge amounts of money and it is not difficult to understand why ECDs are targeted. A simple American internet search using the term "TASER LAWYER" results in several sites that provide misinformation and offer to evaluate any ECD exposure for litigation.[6 7]

The Role of News Media and Popular Press in Shaping Public Opinion

Before discussing current ECD research, it is important to point out the need and demand for this type of research. News media in America has, perhaps, done the most disservice towards ECDs with regards to shaping unfounded opinions. It is the obligation of the news media to be truthful in their reporting but it is also their job to sell newspapers and attract audiences. In order to do this, there is some inherent sensationalism that occurs which may or may not be intentional.

A comparative example of this sensationalism is seen in the following 2 headlines:

- "Man dies after being taken into custody in Livingston County"[8]
- "Man dies after Denver police shoot him with Taser"[9]

In the first case, there was no ECD used prior to the subject's death. In the second case, an ECD was used prior to the subject's death. So technically, both are truthful, but they are not equivalent. In order for them to be equivalent, the first headline should include that no ECD was used. However, this lacks the sensationalism of the second headline which implies that the TASER is somehow linked with regard to causation. In the second case, the cause of death was eventually listed as due to a lethal illicit drug level but this was not known for many weeks after the headline ran. Unfortunately, the reader of the headline is left with the distinct impression that the man's death was caused by a TASER ECD and will likely remember nothing else about the event. When the cause of death is finally revealed in the press, the same reader will likely not even remember the original case and so will not associate it as an exoneration of ECD technology. This is compounded by the fact that headlines announcing a SD usually are prominent, front-page issues. Announcements of true causes of death following autopsy and weeks of investigation rarely rate this sort of prominence.

A final example of this media dramatization is the running tally of ECD associated deaths found on some media and civil rights organizations web sites.[10 11] The problem with this "death tally" is that the data is gathered and presented in a non-scientific fashion designed to sensationalize the issue. It is interesting to note that the "death count" posted by these groups is never adjusted downward. For instance, when a death occurs proximal to an ECD application, that death is counted in their total number reported. When the investigation is over and a cause of death has been assigned by a forensic medical examiner that does not include the ECD, this death remains counted in their database as a death due to the contributory effect of ECD. This is disingenuous to the lay public and adds to their confusion and misinformation. There are several examples of this that demonstrate an ECD being used against an armed subject. In these encounters, the ECD proves to be ineffective (usually secondary to one of the probes not making contact. The police than resort to using their firearms on the subject that results in death or the subject inflicts a fatal wound on themselves with their own weapon.[12 13] Because the ECD was deployed against these subjects, these are counted as ECD associated deaths when the ECD had no meaningful participation in the encounter.

A Discussion About Logic

Another issue that demonstrates the need for appropriate ECD research to consider is whether or not inappropriate logic is being utilized when examining a possible association between ECD use and SD events. Because SD events occasionally follow shortly after an ECD is used on a subject, it is tempting to draw an association between the two simply because of their close association by time sequence. This concept is known as post hoc, ergo propter hoc ("after this, therefore because of this").

A simple but obvious example of post hoc, ergo propter hoc logic would be when roosters crow in the morning . . . shortly after the rooster crows, the sun rises. Using post hoc, ergo propter hoc logic would lead one to believe that the two events described are related because they occur close together in time. The two events are obviously not related and if the rooster doesn't crow the sun still rises. The problem with making simple time associations as the basis for one's logic is that time associations do not really establish causation. In order to do so, you need to consider other factors such as the probability of chance, the inherent diurnal nature of roosters which causes them to crow in the morning and the fact that the sun will rise every morning because of the laws of the solar system. After considering these other factors, it is clear that the crowing of the rooster and the rising of the sun are not causally related at all.

This concept of inappropriate logic cannot be overstated. This is the exact reason why so many people believe that ECD use and SD events are related. This applies not only to laypersons but also to educated professionals. It is very easy to make these associations when events or concepts are not easily understood. In fact, the concept of flawed logic as it relates to SD events has been pointed out in the past.[14] ECDs and sudden death are not easily understood concepts and therefore tend to be at high risk for misunderstanding and inappropriate logic.

Current Human Research

ECD Use and Cardiac Rhythm Physiology

Because ECDs involve the transmission of electrical current, when theories of ECD associated deaths were first considered, the etiology most often entertained was one of electrocution. Electrocution is known to cause death through creating an abnormal, non-perfusing heart rhythm. Therefore, many of the initial human research studies concentrated primarily on investigating the possibility of abnormal heart rhythms.[15] [16] Evaluations of rhythm strips (Levine, et al.) and 12-lead electrocardiograms (Ho, et al.) performed before and after ECD application in resting volunteers demonstrated no detectable changes.

Other studies designed to look at heart rhythm using novel methodology such as real-time echocardiography are currently in progress[17] as researchers still examine this area for a possible association although none has yet been found. Based on the available known data, there is no evidence in human studies that demonstrate ability of ECDs to primarily cause abnormal cardiac rhythms.

There has been a single report in the medical literature that insinuates the use of an ECD on a human resulted in the abnormal heart rhythm of ventricular fibrillation.[18] Upon reviewing the paramedic report for this case, it was shown that the subject received an ECD application by law enforcement due to violent behavior and exhibition of an agitated state. The subject was successfully subdued but found to be in cardio-respiratory arrest 14 to 23 minutes after ECD application. This non-instantaneous collapse is similar to every other case that we have described in my previous surveillance study.[2] The fact that the subject did not experience an instant collapse speaks against the likelihood of the ECD being causative of this arrhythmia.

ECD Use and Cellular Physiology

While looking for a possible cardiac ECD rhythm effect, research has turned to also looking for clues at the cellular level. It has been postulated that ECD exposure potentially could cause physiologic changes at the cellular level and thus contribute to SD events. Specific research examining this theory (Ho, et al.) has involved examination of blood serum physiology and allows researchers to not only evaluate biomarkers of cardiac damage but also biomarkers of skeletal muscle damage and other organ function. To date, published work does not demonstrate an association between ECD application and evidence of significant cellular damage.[16]

This work also looks specifically at another theory based on electrolyte abnormality. It is a medical fact that the condition of elevated serum potassium (known as hyperkalemia) can lead to dangerous and potentially fatal heart rhythms. The work cited above also examined this possibility and found no evidence of potassium elevation following ECD exposure in human volunteers.

ECD Use in Altered Physiologic States

Another area of research interest has been in the methodology of reproducing more similar physiologic states that persons likely are in when they are receiving ECD applications in the field. Initial human research has been conducted on volunteers in resting states. It has been postulated that while ECD exposures to humans in resting, unaltered states do not demonstrate significant physiologic change, perhaps ECD exposures to altered physiologic states might. There are now several completed studies that have simulated different physiologic states in human volunteers for the purposes of studying the effect of ECD exposure on these populations. These states include acidosis, exhaustion and intoxication. This data has been accepted for presentation at a medical research conference and has failed to demonstrate results that are significantly different from studies done on resting populations.[19 20 21]

ECD Use and Respiratory Physiology

Some of the latest human ECD research is now concentrating on areas not related to the cardiac system. One of the latest areas of interest has been whether or not ECD exposure can interrupt the normal respiratory physiology of a human so as to contribute to a SD event from asphyxiation or contribution to worsening acidosis. A recently peer-reviewed study has been completed to examine this area of question.[22] This is the first human data that has been brought forward in this area. The results indicate that human subjects maintain the ability to breathe during ECD application. Additionally, this study demonstrates that the quality of this breathing is able to exceed the normal respiratory pattern and does so consistently from subject to subject.

This study specifically examined the theoretic "worst case scenario" and placed ECD probes in a trans-thoracic position above and below the diaphragm. It also utilized a prolonged ECD exposure time of 15 seconds delivered in 1 of 2 random patterns (intermittent or continuous). This study effectively puts to rest any theories of ECD asphyxiation.

ECD Use and Thermoregulation

Another area of study is in regards to the effect of ECD exposure on human core temperature.[23] It has been a concern of many to determine if ECD exposure has an effect on human thermoregulation. This is because many SD events involve hyperthermia at the time of death. In this study, volunteers had their core temperatures monitored for 24 hours via a swallowed transmitting thermometer device. This reported a core temperature value every 15 seconds to an external recording device.

During the course of the 24 hour monitoring period, volunteers underwent a prolonged ECD application of 15 second duration. They demonstrated no detectable change in core temperature during or after the application. This study is currently under peer-review for publication but appears to indicate that there is no evidence that ECD application contributes to a hyperthermic response in humans.

ECD Use and Mental Illness

A final area of study to consider that has received recent scrutiny is the use of ECDs upon the mentally ill population. This is another example of a human population that is difficult to study in a prospective fashion. The mentally ill fall into a research category afforded special protections because of their inability to provide informed consent. Therefore, any conclusions about ECD use within this population are based upon anecdotal or retrospective evidence.

There is no existing medical evidence to show that application of electricity to mentally ill persons would physiologically be any different than non-mentally ill persons. In fact, electricity is used with regularity among certain mentally ill populations as a therapeutic technique.[24]

I am aware of only a single body of data looking specifically at ECD use among the mentally ill population which has been presented publicly and is scheduled for publication.[25] [26] This data looked specifically at a voluntarily reported set of data for ECD use and impact on outcome in mentally ill and acutely suicidal populations. It found that ECDs appear to be a common method of control for these populations and that in nearly 50% of the study population, the ECD was used in place of a firearm even though the law enforcement use of deadly force would have been authorized and justified in these situations. Another way to translate this is that the presence of an ECD at the scene of a mentally ill or acutely suicidal person resulted in the potential saving of human life nearly 50% of the time.

Conclusion

There appears to be increasing interest in ECD use in society from law enforcement, military and personal defense perspectives. Along with increasing use of these devices, there is also a heightened awareness of perceived association with SD events. This perception may be stimulated by media inaccuracy and sensationalism at times. It may also be the product of misapplied logic.

There have been numerous human studies investigating the possible association between ECD application and SD events. To date, no clear association has been demonstrated when examining the currently recognized etiologies of sudden death such as cardiogenic, pulmonary, metabolic or thermoregulatory causes. Additionally, data exists to show that ECD use has the potential to save human lives within certain populations. We believe that further study of ECDs is recommended to validate our findings.

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