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HUMAN RESEARCH REVIEW OF THE TASER® ELECTRONIC CONTROL DEVICE

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TASER Electronic Control Devices have become mainstream methods of applying electricity to control unruly suspects. There has been speculation that they may be associated with worsening human physiology or death. The lay impressions that these devices are unsafe are not founded on known human research findings. This presentation briefly reviews the most pertinent human research on this subject.

Keywords — **Cardiac, Human studies, Safety, Sudden death, TASER.**

I. INTRODUCTION

The TASER Electronic Control Device (ECD) was first introduced in the 1970's. In 2003, the TASER X26 was produced and has become the most widely used ECD in the world. Since its introduction, there have been many human research studies done on this device in attempts to determine if it has the ability to induce dangerous physiologic changes or death. We review the most pertinent and important human studies that pertain to the ECD and the important conclusions that can be made.

II. HUMAN STUDIES

ECDs are intended for use primarily on humans and it is fortunate that a plethora of human study results are currently in existence with more becoming available each month. The range of human studies has covered examinations of associated behaviors, replication of compromised physiologic conditions, and varying exposure durations, application modes, and physiological measurements.

Observational and Retrospective Studies

The largest amount of retrospective data is that reported by ECD manufacturer TASER International, Inc. (Scottsdale, Arizona) that cites over 685,000 voluntary training exposures with no deaths. These exposures have occurred in a variety of conditions on a population of varying age and health. This large number of exposures without subsequent, associated death supports the safety of the ECD when considered as an isolated factor.

The above manufacturer data has also been supported by 4 retrospective studies. The studies by Ho, et al and Strote, et al had correlative conclusions.[1] [2] The majority of deaths that occurred following ECD application were found to be highly associated with conditions of illicit stimulant intoxication and delirious behavior. Additionally, Ho, et al showed that the vast majority (70%) of sudden, unexpected deaths occurring in law enforcement interactions occur when no ECD has been involved. A smaller study by McManus, et al also supports this finding.[3] And the largest study to date by Bozeman, et al evaluated over 1,201 subjects after ECD use in true field conditions with zero deaths that were felt to be due to the ECD and 99.75% of encounters with minimal to no injury.[4] Similar results were found by Eastman et al.[5]

Prospective Clinical Studies

The Ho, et al group from Minneapolis, MN has conducted their research via partial manufacturer funding with oversight from an independent institutional review board. The Vilke, et al group from San Diego, CA has conducted their research primarily via federal funding. Both groups have conducted many studies with similar conclusions. These studies have largely been before/after sampling methodology for 1-15 second exposure durations in a variety of thorax positions and with varying underlying physiologic conditions being present.

The first human data study examined rested subjects with a 5-second exposure.[6] There were no changes in electrocardiograms, cardiac troponins or electrolytes. There were slight elevations in lactate and creatine kinase as would be expected from skeletal muscle activation. Other studies have verified these findings.[7] [8] However, these studies have been performed using rested subjects.

Because of this, other studies examining abnormal conditions have been performed. The condition of intoxication has been looked at by Moscati, et al using volunteers with a mean ethyl alcohol level of 0.11 mg/dl.[9] The condition of electrocardiograph changes and metabolic acidosis has also been examined by Ho, et al and Vilke, et al.[10] [11] [12] The general conclusion of these studies is that none have found any clinically significant changes that would be associated with worsening physiology.

Hand-held ECDs in use today can be applied to subjects in 2 primary ways (deployment of probes or direct contact often known as the "drive stun"), and thus the question of whether there is a difference in physiologic effects between the methods of application has been raised. Most human studies to date have involved probe deployment or simulation of this method. In 2007, Ho, et al presented work looking specifically at the drive stun method of application and found that there was no marked worsening in physiology.[13] A hybrid modes of application exists in which current is passed from a single probe and the fixed electrodes on the

ECD. This method cannot deliver more charge to the body (and typically delivers less) and thus does not require separate study.

Some other human studies examining other conditions involving ECDs have been published and deserve mentioning. Dawes, et al have looked at both the association of ECD application with core temperature changes and found that that an ECD exposure does not cause core temperature elevation. [14] He also studied the neuroendocrine effects of an ECD application compared to other painful stimuli. [15] Their conclusions were and that this exposure is less activating of the human stress response. Both findings support the safety of the ECD when used upon subjects where temperature elevation may be of concern (e.g., extreme agitation/delirium conditions, stimulant intoxication). Ho, et al has also begun to examine the relationship between ECD application, acidosis and excess catecholamine surge and is finding that ECD application is among the safest option for suspect control.[16]

The Ho, et al group has also looked at emerging ECD hand held and projectile technology. First generation technology has been tested on long duration exposures up to 45 seconds in length. Initial studies of this demonstrate similar effects on respiration and physiology as has been seen in all of the other human testing.[17]

The final two studies that need to be discussed involve those that have specifically found results that are opposite from what are found in some animal models. First, Ho, et al uniformly found that all human volunteers breathe during a prolonged ECD exposure with increased minute ventilation measurements.[18] This is opposite of prior animal studies that concluded that respiratory arrest occurred during exposure. We believe the difference is likely due to the profound effects of anesthesia used in animal work. The second study is also from the Ho, et al group that exposed human volunteers to an ECD with electrodes aligned in an ideal cardiac axis while observing cardiac activity in real time with echocardiography.[19] There were no episodes of cardiac arrhythmia, dysrhythmia or capture. This is an opposite finding of the Nanthakumar, et al and Dennis, et al groups using swine models. We believe the differences found are likely due to body mass, anatomic shape, and cardiac electrophysiological differences between animal and human models. This needs to be considered when studying the animal ECD literature.

III. CONCLUSION

The TASER ECD has been in existence for several years. A review of the available literature demonstrates that human research in this area has improved the understanding of the effects and the limits of this device. The known human data does not support a causal association between the TASER ECD and sudden death or clinically worsening physiology.

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