New Medical Research Disproves the Acidosis Theory of Liability Used in the Heston Case

TASER ECD Does not Cause Dangerous Levels of Acidosis

Background. TASER International periodically provides updates on medical research findings regarding the physiologic effects of electronic control devices (ECDs) on human and animal subjects. This Training Bulletin contains the most recent research findings as of the date of release.

Synopsis

Law enforcement personnel are frequently called upon to deal with individuals in crisis who are physiologically compromised and are at a heightened risk of serious injury or death, regardless of actions taken by law enforcement. In addition, the restraint and arrest process can introduce additional physiologic changes that may worsen a person's baseline physiology. These changes may include significant acidosis, cardiac arrest, or other medical conditions.

Acidosis:

- Recent human medical research determined that muscle contractions from TASER ECD exposures for up to 10 and 15 seconds in rested human subjects resulted in minimal increases in acidosis that did not approach a dangerous level and was clinically not noticed by the test subjects.

- This research also showed that application of a TASER device for up to 15 seconds to an exerted, already acidotic person did not worsen the acidosis that was already present.

- This medical research disproves the "straw that broke the camel's back theory" of worsening acidosis that theorizes that the physiologic effect from a TASER device discharge on an already acidotic person was an added acidosis "straw" that contributed to death from acidosis. This was essentially the theory of liability used in the *Betty Lou Heston, et al. v. City of Salinas, et al.* (CA) lawsuit. This new research reveals the flaws in this jury verdict since application of a TASER device for up to 15 seconds to an exerted, already acidotic person did not worsen the acidosis that was already present.

- In comparing volitional actions by the individual, the top two worst things that a criminal suspect could do with regard to acidosis are resist and flee – in that order. These two volitional actions produce profound metabolic acidosis that can make the suspect very ill (in addition to any other volitional behaviors that they may have undertaken such as abuse of illicit drugs or consuming a significant amount of alcohol). When compared with a TASER device application, this research data indicates that a continued, prolonged resistive struggle or a foot chase is more dangerous.

- The TASER device, with a good probe spread may represent the best option that will allow quick restraint and EMS care.

Cardiac:

- Human research has shown that the immediate induction of ventricular fibrillation, an arrhythmia that can be fatal without intervention, by the direct electrical effects of the TASER X26 on the normal adult heart is unlikely and that the induction of delayed cardiac arrest by this mechanism is extremely unlikely.

- Researchers have concluded that the a close distance between the ECD dart and the heart is the primary factor in determining whether an ECD will affect the heart. This risk is judged to be extremely low in field use.

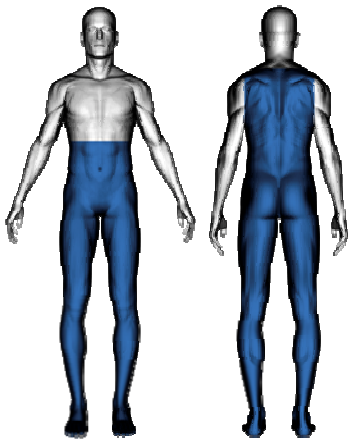
- The risk of an adverse cardiac event related to a TASER ECD discharge is deemed to be extremely low. However, it is not possible to predict nor test against the entire spectrum of potential human physiologies or conditions such as unpredictable combinations of drugs of unknown concentration or origin in the presence of underlying cardiac or other disease. Furthermore, a law enforcement officer will have no means to diagnose these factors in any event.

- Sudden Cardiac Arrest (SCA) is a leading cause of death in the United States, claiming an estimated 325,000 lives each year. These deaths occur on golf courses, in airports, during physical exertions, from startle or other stimuli, or just about anywhere. Should Sudden Cardiac Arrest occur in a scenario involving a TASER discharge to the chest area – it would place the law enforcement agency, the officer, and TASER International in the difficult situation of trying to ascertain what role, if any, the TASER ECD could have played in a unique situation that cannot be replicated in human clinical safety evaluations. In order to reduce the risk of such an event, and in light of the fact that frontal applications of TASER ECDs have been found to be more effective when the probes are targeted at the lower torso (engaging the balancing muscles of the pelvic triangle) we have lowered the recommended point of aim from the center of mass to the lower center of mass for frontal discharges. We believe this recommendation will improve the effective use of TASER ECDs while also further increasing safety margins and enhancing the ability to defend such cases in post event legal proceedings.

Overview and Training Implications

1. **We have issued a new TASER Targeting Guide that will apply for the new XREP impact munition as well as ECDs such as the X26, M26 and X3.** Note, we have lowered the recommended point of aim from center of mass to lower-center of mass for front shots. The blue highlighted area in the adjacent target man represents the preferred target area. There are three reasons:
    a. Simplify targeting for all TASER systems to one easy to remember map, avoiding chest shots when possible and the risk of a head/eye shot in a dynamic situation, as is standard for impact munitions
    b. When possible, avoiding chest shots with ECDs avoids the controversy about whether ECDs do or do not affect the human heart.
    c. Close-spread ECD discharges to the front of the body are more effective when at least one probe is in the major muscles of the pelvic triangle or thigh region.

in Blue



Back shots remain the preferred area when practical.

2. **When dealing with exhausted individuals or persons exhibiting symptoms of distress or agitated/excited delirium:**

    a. **Once officers engage in capture procedures, it is important to minimize the duration of the physical struggle.** New research shows that physical struggle, simulated by punching a heavy bag at full intensity, can cause acidosis that can reach dangerous levels in only 45 seconds of intense exertion, starting from a resting state. Accordingly, officers engaging subjects in a physical struggle or in an exhaustive state should develop a plan to capture and

restrain the subject as expeditiously as possible to minimize the duration of struggle and the adverse physiological effects. The physiologic effects of a TASER ECD discharge of up to 15 seconds was significantly less than that of either fleeing (simulated with a sprint) or fighting (simulated with the heavy bag). This research shows that the TASER ECD, as part of an overall capture plan, is a viable option to help minimize the duration of the struggle.

b. **When encountering subjects exhibiting symptoms of exhaustion, distress or agitated/excited delirium, refer to your agency's guidelines for proper response.** These subjects are at significant risk of arrest-related death. Immediate medical attention may reduce this risk.

3. **The primary risk of serious injury or death during ECD deployment is risk related to falls. Users should be reminded to avoid deploying ECDs on persons on elevated platforms or other places where a fall can be more injurious.**

This bulletin should be distributed to all ECD-certified officers.

Medical Research Update Details

Recent human medical research continues to affirm the general safety of TASER® electronic control devices (ECDs or devices).[1] In 2008 alone, over 30 new medical studies were published in paper, abstract, or poster form on TASER technology. Some of these studies presented ground breaking research in the areas of human physiological changes and cardiac safety. In addition, several new ECD field-use epidemiological studies were published.[2] Dr. James Jauchem published a new article on deaths in custody[3] focusing on excited delirium and ECDs.[4] Two new books were published, one solely dedicated to ECDs[5] and one with a significant chapter on ECDs.[6] Some of these studies provided substantial evidence confirming generally held beliefs regarding the effects of law enforcement force and restraint in the areas of human physiological changes and cardiac safety.

Physiologic Changes[7]

Law enforcement personnel are frequently called upon to deal with individuals in crisis who are physiologically compromised[8] and are at a heightened risk of serious injury or death. The restraint and arrest process can introduce additional physiologic changes that may worsen a person's baseline physiology. These changes may include significant acidosis, cardiac arrest, or other medical conditions[9]. Recent US Bureau of Justice Statistics showed 2,002 US arrest-related deaths for the period 2003-2005; 55% of which were homicides, 13% involved drugs or alcohol, and 0.1% involved use of a baton or TASER device.

A. Acidosis

Acidosis refers to a condition of decreasing pH (usually measured in blood plasma). Although numerous conditions can cause acidosis, law enforcement personnel commonly confront individuals who are susceptible to developing acidosis because of the individual's behaviors that may include: illicit or prescription drug use, intoxication, agitation, delirium, physical exertion, fighting, resisting arrest and restraint, or fleeing from officers. Many of these behaviors occur in combination and may be additive.

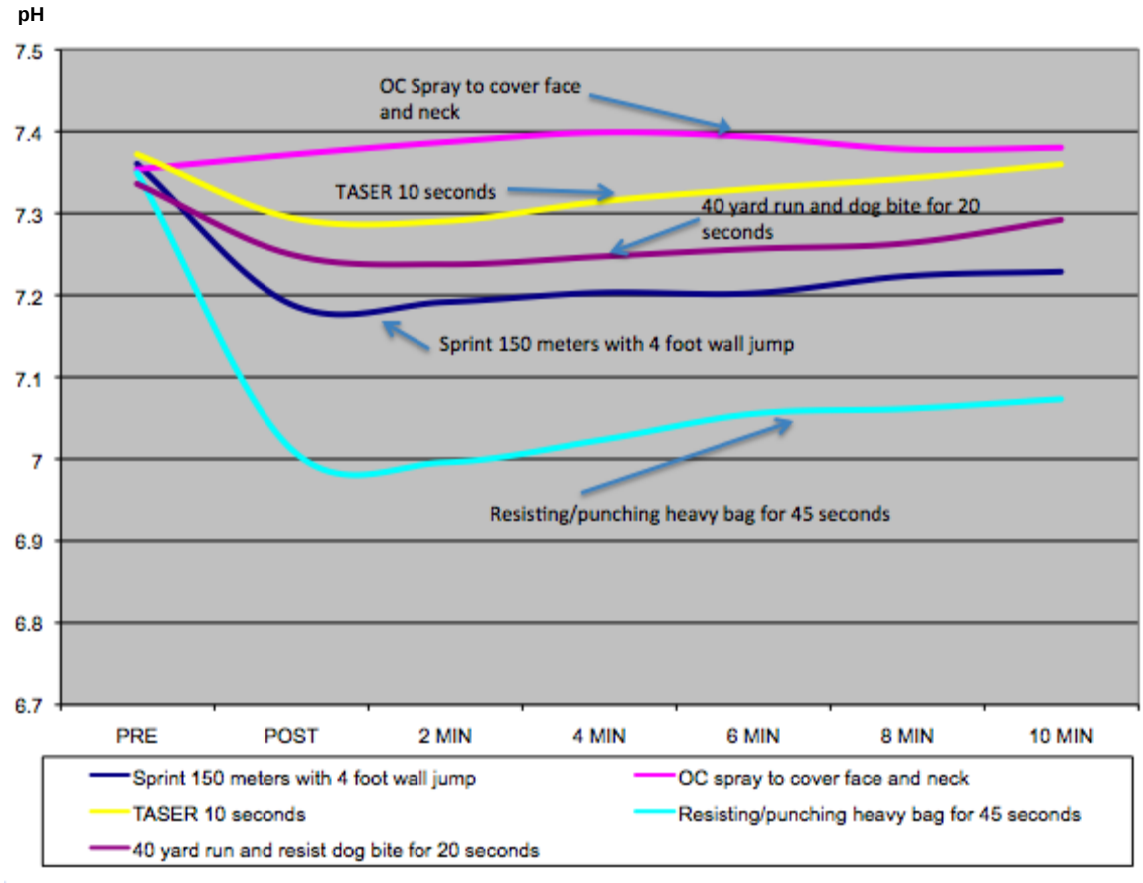
Acidosis is a condition that occurs across a spectrum. While both a pH of 7.35 and 6.20 indicate an acidotic state; these 2 pH levels are clinically very different. The lower value of 6.20 is likely to be lethal and the upper value of 7.35 would likely not even be physically noticeable to an individual. An individual can be acidotic (by definition) but NOT be in any danger physiologically. For instance, briskly walking up flights of stairs would make most people acidotic, but would not put one in any medical danger.

Recent human medical research investigated the physiologic health risks associated with physical exertion similar to resisting arrest or fleeing from police officers, as well as, those risks associated with certain law enforcement control tools. The three law enforcement control tools tested for their effects on causing acidosis were law enforcement canine for capture and restraint, oleoresin capsicum (OC) spray exposure to the face and neck, and TASER ECD exposure for 10 and 15 seconds to the torso. The researchers measured acidosis changes associated with the above physical exertion and police tools and found the following:

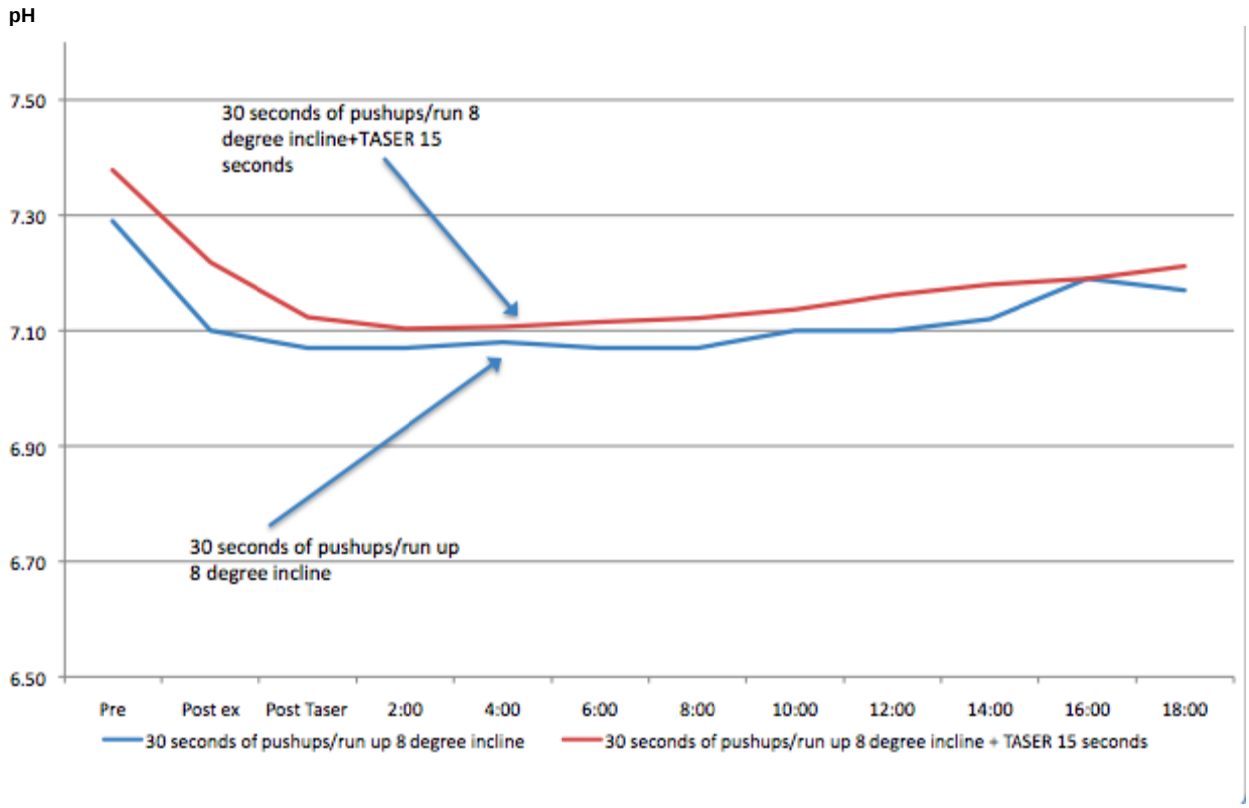
- Muscle contractions from TASER device exposures for up to 10 and 15 seconds in **rested** human subjects resulted in minimal increases in acidosis that did not approach a dangerous level and was clinically not noticed by the test subjects.
- Physical activity similar to fighting and resisting or fleeing from law enforcement produced the worst and most clinically significant acidosis. This volitional activity was clearly the most potentially harmful from a physiologic standpoint and the test subjects clinically felt ill following this activity.
- Canine takedown and restraint had the highest increase of acidosis levels of th**e law enforcement tools tested**.
- OC spray had the least increase in acidosis levels of the **law enforcement tools tested**. This was expected since TASER device application stimulates muscles and OC spray does not. The researchers opined that since OC spray does not usually incapacitate a focused person or a person intoxicated on drugs or alcohol, **the fight or flight is likely to continue and may result in**

worsening acidosis. It is likely that OC spray, while not directly causing acidosis, could indirectly make it worse.

Following is a pH graph that depicts these results. The least amount of decrease in pH is the safest.



- Recent human medical research also investigated the physiologic health risks associated with a TASER discharge on an already acidotic person. **This research showed that application of a TASER device for up to 15 seconds to an exerted, already acidotic person did not worsen the acidosis that was already present.** The following graph depicts these test results:



- This medical research disproves the "straw that broke the camel's back theory" of worsening acidosis that theorizes that the physiologic effect from a TASER device discharge was an added acidosis "straw" that contributed to death from acidosis. This was essentially the theory of liability used in the *Betty Lou Heston, et al. v. City of Salinas, et al.* (CA) lawsuit which resulted in a jury finding that the TASER device contributed 15% to Heston's death while his own actions, which included methamphetamine intoxication, prolonged physical exertion and resisting arrest; contributed 85% to his death. This new research reveals the flaws in this jury verdict since application of a TASER device for up to 15 seconds to an exerted, already acidotic person did not worsen the acidosis that was already present.

In comparing volitional actions by the individual, the top two worst things that a criminal suspect could do with regard to acidosis are resist and flee – in that order. These two volitional actions produce profound metabolic acidosis that can make the suspect very ill (in addition to any other volitional behaviors that they may have undertaken such as abuse of illicit drugs or consuming a significant amount of alcohol). When compared with a TASER device application, this research data indicates that a continued, prolonged resistive struggle or a foot chase is more dangerous. It appears that it is these physical actions of resisting and fleeing that will most worsen acidosis. While the scientific studies were able to demonstrate this profound effect on acidosis with only 45 seconds of exertion, many arrest-related struggles last much longer.

Based on the research data referenced above, by the time the officers arrive, many suspects are already significantly acidotic from their own volitional actions – likely with lower pH levels resulting in an increased chance of injury, worsening condition, or possibly death, independent of any other action taken by the police officers. Potential danger exists in allowing the suspect to continue with agitated or resistive behavior. Prolonging restraint by allowing a fight or a fleeing situation may only serve to worsen the suspect's condition. The TASER device, with a good probe spread may represent a tool that will allow quick restraint and EMS care.

Human medical tests have, for the most part, been limited to 15-second ECD applications. Recent animal research tested the physiological effects of ECD exposures up to 30 minutes on anesthetized swine and concluded that "The dose does not seem to be cumulative. We did not observe an accumulation of the TASER® [ECD] effect to a 'toxic' level. There was no increased mortality with longer durations of TASER [ECD] exposure".[10]

Please see "Attachment A" for a summary of related human medical research.

B. Cardiac

The conclusions of recently published human medical cardiac studies are summarized as follows:

- In summary, this review of the scientific literature suggests that the immediate induction of ventricular fibrillation by the direct electrical effects of the TASER X26 on the normal adult heart is unlikely and that the induction of delayed cardiac arrest by this mechanism is extremely unlikely.[11]

- Although heart rate increased in some cases, there were no cardiac dysrhythmias, or interval morphology changes in human subjects who received a TASER discharge based on a 12-lead ECG performed immediately before and within 1 minute after a TASER device activation.[12] The cardiac changes were also evaluated in acidotic, exhausted humans and the same conclusion was reached.[13]

- Prolonged 15-second ECD application in a physically exhausted adult human did not cause a detectable change in their 12-lead ECGs. Theories of CEW-induced dysrhythmias are not supported.[14]

- A 10-second ECD exposure in an ideal cardiac axis application did not demonstrate concerning tachyarrhythmias using human models. The swine model may have limitations when evaluating ECD technology.[15]

- In a resting adult population, the ECD did not affect the recordable cardiac electrical activity within a 24-hour period following a standard 5-second application. The authors were unable to detect any induced electrical dysrhythmias or significant direct cardiac cellular damage that may be related to sudden and unexpected death proximal to ECD exposure. Additionally, no evidence of dangerous hyperkalemia or induced acidosis was found. The authors recommended further study in the area of the in-custody death phenomenon to better understand its causes.[16]

- Human volunteers exposed to a single shock from a ECD did not develop an abnormal serum troponin I level 6 hours after exposure, suggesting that there was no myocardial necrosis or infarction.[17]

- CEW [Conducted Energy Weapon or ECD] exposure produced no detectable dysrhythmias and a statistically significant increase in heart rate. Overall, TASER CEW exposure appears to be safe and well tolerated from a cardiovascular standpoint in this population. This study increases the cumulative

human subject experience of CEW exposure with continuous ECG monitoring and includes 28 full 5-s exposures[18].

- Relatively large variations about the X26 operating level were found not to result in fibrillation or asystole[19].

- CEW exposure produced no detectable dysrhthmias and a statistically significant increase in heart rate. Overall, TASER CEW exposure appears to be safe and well tolerated from a cardiovascular standpoint in this population. This study increases the cumulative human subject experience of CEW exposure with continuous ECG monitoring and includes 28 full 5-s exposures[20].

Conclusion regarding the potential for cardiac effects: Researchers have been able to demonstrate changes in heart rate and rhythm consistent with cardiac pacing and, in some cases, ventricular fibrillation (VF) in small swine, an arrhythmia that can be fatal without intervention, and have concluded that the a close distance between the ECD dart and the heart is the primary factor in determining whether an ECD will affect the heart. The threshold for VF has been estimated to be 12.6 times that for cardiac pacing[21]. This risk is judged to be extremely low in field use. In order to increase the safety margin and since field experience shows that ECD discharges are effective when deployed to the large muscles of the back, abdomen, legs and pelvic triangle, users should aim for the back or (when practical) toward the mid lower abdomen and avoid intentionally targeting the chest area with probe applications to increase effectiveness and avoid the remote potential risk of cardiac effect.

Revised Warnings

Attached are the new Product Warnings which have been updated based on this new human medical research. Go to www.TASER.com for the complete Product Warnings document and glossary of terms for Law Enforcement.

Any questions regarding this Training Bulletin should be directed to the TASER International Training Department at (800) 978-2737 or by email to Training@TASER.com.

ATTACHMENT A

Acidosis

- Acidosis is worse from continued exertion when compared to a TASER device application. This does not support an association between TASER device applications and sudden death due to worsening acidosis. It does support a worsening acidosis from continued exertion independent of TASER device application.[22]

- The TASER XREP™ projectile is new technology that will be used to control dangerous, agitated or potentially violent persons in the community. It will allow greater law enforcement and suspect safety because of its ability to help control individuals from a greater distance. The initial investigation into the physiologic effect that this device will have on humans with regard to serum biomarkers was done with the unfinished product while under development. Prolonged ECD application with this initial design caused small but statistically insignificant changes in measured serum biomarkers. These small changes would likely result in limited clinical significance. It appears that the tested developmental XREP ECD represents an adequate risk/benefit ratio if used for its intended purpose.[23] Further testing of the final XREP product is now underway.

- There were no clinically significant or lasting statistically significant changes in cardiovascular, electrolyte, lactate or pH levels in human subjects after a 5 second TASER activation.[24]

- Markers of acidosis and cardiac injury were similar among acidotic subjects who underwent both sham and real prolonged CEW exposure. Prolonged CEW exposure in humans does not appear to have an effect with regard to worsening acidosis that is already present.[25]

- There were no worrisome changes in measured serum biomarkers. There was a significant decrease in serum lactate after exposure. This data does not support a causal relationship between ECD drive-stun applications and worsening physiology.[26]

- In this resting adult population, the TASER X26 device did not affect the recordable cardiac electrical activity within a 24-hour period following a standard five-second (s) application. The authors were unable to detect any induced electrical dysrhythmias or significant direct cardiac cellular damage that may be related to sudden and unexpected death proximal to CEW exposure. Additionally, no evidence of dangerous hyperkalemia or induced acidosis was found. Further study in the area of the in-custody death phenomenon to better understand its causes is recommended.[27]

- Cardio-respiratory and blood parameters were followed before and for 60 min after a 5 s TASER exposure on 21 men and women law enforcement officer volunteers.[28]

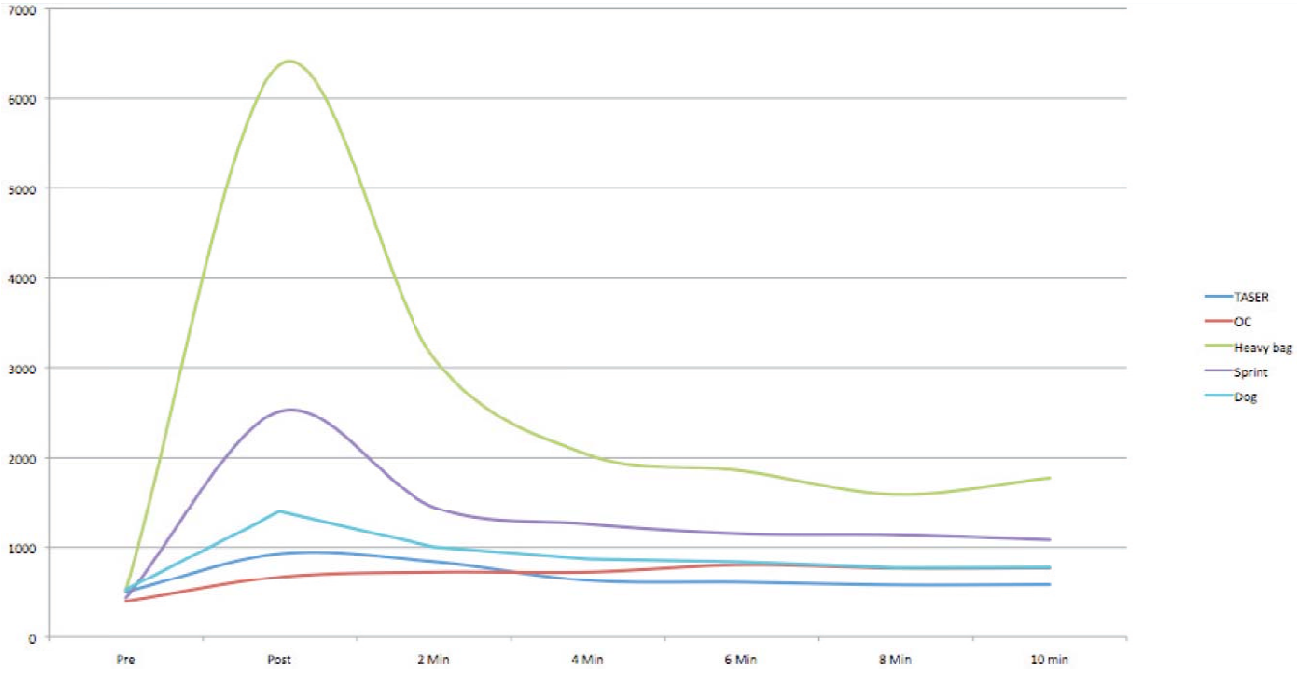
- …the repeated use of electro-muscular incapacitating devices in a short period of time is, at least, feasible, with the caveat that some medical monitoring of subjects may be required (to observe factors such as lactate and acidosis).[29]

- Three repeated TASER device exposures had only transient effects on blood factors, which all returned to pre-exposure levels, with the exception of hematocrit (which remained elevated after 3 h). Since the increase in this factor was less than that which may occur after short periods of exercise, it is unlikely that this would be an indicator of any serious harm.[30]

- Intoxicated adults with prolonged CEW exposure demonstrate small transient increases in measures of acidosis and no change in markers of cardiac injury. The increased acidosis was not clinically significant and self corrected.[31]

Stress

- Alpha-amylase had the greatest increase from baseline at 10–15 min with the defensive tactics drill. Cortisol had the greatest increase at 15–20 min with O.C. spray. Cortisol remained most elevated at 40–60 min in the defensive tactics drill group. Our preliminary data suggests that physical exertion during custodial arrest may be most activating of the human stress response, particularly the sympathetic-adrenal-medulla axis. This may suggest that techniques to limit the duration of this exertion may be the safest means to apprehend subjects, particularly those at high-risk for in-custody death. Conducted electrical weapons were not more activating of the human stress response than other uses of force.[32] Please see the following graph:



- A 5-second exposure of a TASER X26 [device] to healthy law enforcement personnel does not result in clinically significant changes of physiologic stress.[33]

[1] For a complete listing see the most current Electronic Control Device Research Index posted on TASER International, Inc's (TASER) website at www.TASER.com.

[2] Bozeman WP, Hauda WE, 2nd, Heck JJ, Graham DD, Jr., Martin BP, Winslow JE. Safety and Injury Profile of Conducted Electrical Weapons Used by Law Enforcement Officers Against Criminal Suspects. Ann Emerg Med. Jan 21 2009.

[3] For more information on excited delirium and custody related death issues see the Custody Related Death Research Index posted on TASER's website at www.TASER.com, and www.incustodydeath.com.

[4] Jauchem, PhD, James R., Deaths in custody: Are some due to electronic control devices (including TASER® devices) or excited delirium? Journal of Forensic and Legal Medicine, doi:10.1016/j.jflm.2008.05.011.

[5] Mark W. Kroll (Editor), Jeffrey D. Ho (Editor).TASER® Electronic Control Devices: Physiology, Pathology, and Law. Springer.

[6] Edited by Raymond M. Fish and Leslie A. Geddes, Lawyers & Judges Publishing Company, Inc. Electrical Injuries: Medical and Bioengineering Aspects, Second Edition, Chapter 42: TASER Electronic Control Devices.

[7] "Physiologic changes" include, but are not limited to, changes in: heart rate; heart rhythm; stress hormones or other biochemical neuromodulators *(e.g.,* catecholamines); respiration; adrenergic states; tissue temperature; myoglobin; potassium; creatine kinase; lactic acid, or pH.

[8] "Physiologically compromised" include those persons whose lives in rare circumstances may be at risk of arrest-related death due to excited or agitated delirium, acidosis, cardiac arrest, serotonin syndrome, neuroleptic malignant syndrome, sudden unexpected death in epilepsy, catecholamine release or buildup, compromised cardiac or pulmonary conditions, sickle cell compromise, and drug or alcohol use or withdrawal.

[9] Such as hyperkalemia, rhabdomyolysis, apnea, increased adrenergic states, or hypercarbia.

[10] Hughes E, Kennett M, Murray W, Werner J, Jenkins D. *Electro-Muscular Disruption (EMD) bioeffects: A study of the Effects of Continuous Application of the TASER X26 Waveform on Swine*: Penn State University Institute for Non-Lethal Defense Technologies; Nov 30 2007.

[11] Raymond Ideker, MD, PhD and Derek J. Dosdall, PhD; Can the Direct Cardiac Effects of the Electric Pulses Generated by the TASER X26 Cause Immediate or Delayed Sudden Cardiac Arrest in Normal Adults? The American Journal of Forensic Medicine and Pathology, Vol 28, No. 3, September 2007.

[12] Vilke GM, Sloane C, Levine S, Neuman T, Castillo E, Chan TC. Twelve-lead electrocardiogram monitoring of subjects before and after voluntary exposure to the TASER X26. *Am J Emerg Med.* Jan 2008;26(1):1-4.

[13] Ho JD, Dawes DM, Heegaard WG, Calkins HG, Moscati RM and JR Miner. Absence of Electrocardiographic Change Following Prolonged Application of a Conducted Electrical Weapon on Physically Exhausted Adults. *J Emerg Med*, 2009;In Press.

[14] Ho J, Dawes D, Calkins H, Johnson M. Absence of Electrocardiographic Change Following Prolonged Application of a Conducted Electrical Weapon in Physically Exhausted Adults. *Acad Emerg Med* 2007;14(5):128-129.

[15] Ho JD, Dawes DM, Reardon RF, et al. Echocardiographic Evaluation of a TASER-X26 Application in the Ideal Human Cardiac Axis. *Acad Emerg Med.* Aug 10 2008.

[16] Ho JD, Miner JR, Lakireddy DR, Bultman LL, Heegaard WG. Cardiovascular and physiologic effects of conducted electrical weapon discharge in resting adults. *Acad Emerg Med.* Jun 2006;13(6):589-595.

[17] Sloane CM, Chan TC, Levine SD, Dunford JV, Neuman T, Vilke GM. Serum troponin measurement of subjects exposed to the TASER X-26. *J Emerg Med.* Jul 2008;35(1):29-32.

[18] Bozeman study Immediate cardiovascular effects of the TASER X26 conducted electrical weapon, W P Bozeman, D G Barnes, Jr, J E Winslow, III, J C Johnson, III, C H Phillips, and R Alson, *Emerg. Med. J.* 2009; 26(8): p. 567-570; http://emj.bmj.com/cgi/content/abstract/26/8/567?ct=ct.

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[20] Bozeman WP, Barnes DG Jr, Winslow JE III, Johnson JC III, Phillips CH, Alson R. "Immediate cardiovascular effects of the TASER X26 conducted electrical weapon," Emerg. Med. J. 2009, 26; 567-570.

[21] Raymond Ideker, MD, PhD and Derek J. Dosdall, PhD; Can the Direct Cardiac Effects of the Electric Pulses Generated by the TASER X26 Cause Immediate or Delayed Sudden Cardiac Arrest in Normal Adults? *The American Journal of Forensic Medicine and Pathology*, Vol 28, No. 3, September 2007.

[22] Ho, J.D., et al., Can Prolonged TASER X26 Exposure or Continued Exertion Contribute to Sudden Cardiac Death Through Worsening Acidosis? 2009, CardioRythm, Hong Kong: Dept. of Emergency Medicine, Hennepin County Medical Center, Minneapolis, MN Dept. of Emergency Medicine, Lompoc Valley Medical Center, Lompoc, CA.

[23] Serum Biomarker Effects of Prolonged TASER XREP Device Exposure, Jeffrey D. Ho, MD, Donald M. Dawes, James R. Miner, MD,, NAME (National Association of Medical Examiners) 2008 Annual Conference (Louisville, Kentucky); European Society of Emergency Medicine Scientific Assembly, Munich Germany Sept 2008.

[24] Vilke G, Sloane C, Bouton K, et al. Cardiovascular and Metabolic Effects of the TASER on Human Subjects. *Acad Emerg Med* 2007;14(5):104-105.

[25] Ho J, Dawes D, Bultman L, et al. Physiologic Effects of Prolonged Conducted Electrical Weapon Discharge on Acidotic Adults. *Acad Emerg Med* 2007;14(5):63.

[26] Ho JD, Dawes DM, Lapine AL, et al. PROLONGED TASER® "DRIVE-STUN" EXPOSURE IN HUMANS DOES NOT CAUSE WORRISOME BIOMARKER CHANGES Hennepin County Medical Center: National Association of EMS Physicians; 2008.

[27] Ho JD, Miner JR, Lakireddy DR, Bultman LL, Heegaard WG. Cardiovascular and physiologic effects of conducted electrical weapon discharge in resting adults. *Acad Emerg Med.* Jun 2006;13(6):589-595.

[28] Bouton K, Vilke G, Chan T, et al. Physiological Effects of a Five Second TASER Exposure. San Diego State University San Diego Heart Institute: Society for Academic Emergency Medicine; 2007.

[29] Jauchem JR, Sherry CJ, Fines DA, Cook MC. Acidosis, lactate, electrolytes, muscle enzymes, and other factors in the blood of Sus scrofa following repeated TASER exposures. *Forensic Sci Int.* Aug 10 2006;161(1):20-30.

[30] Jauchem JR, Cook MC, Beason CW. Blood factors of Sus scrofa following a series of three TASER® electronic control device exposures. *Forensic Sci Int.* Jul 12 2007.

[31] Moscati R, Ho J, Dawes D, et al. Physiologic Effects of Prolonged Conducted Electrical Weapon Discharge on Intoxicated Adults. *Acad Emerg Med* 2007;14(5):63-64.

[32] Dawes D, Ho J, Miner J. The neuroendocrine effects of the TASER X26: a brief report. *Forensic Sci Int.* Jan 10 2009;183(1-3):14-19.

[33] Vilke GM, Sloane CM, Bouton KD, et al. Physiological Effects of a Conducted Electrical Weapon on Human Subjects. *Ann Emerg Med.* Aug 23 2007.