

Sudden In Custody Death and Conducted Energy Weapons

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Are CEW safe?

Field experience with CEW

- Bozeman et al, presented at ACEP 2007
- Field experience with Taser application
- All comers, all applications in 6 agencies
- N= 962 applications
- 2 years, June 2005-June 2007
- 96% were X26, 4% were M26
- 66% probe, 26% drive stun, 8% both
- mean number shocks: 1.6 in probe, 1.8 in drive stun.

Injuries defined in Bozeman

- None/Mild
 - puncture wounds, contusions, lacerations and other soft tissue injuries and two fractures (0.5%)
- Mod/severe
 - rhabdomyolysis in 1 of moderate severity but unclear relationship to CEW
 - cerebral contusion in 1, of moderate severity and sustained after fall post CEW
 - epidural hematoma, severe, and indirectly related to CEW (fall).

Deaths in Bozeman

- 2 in custody deaths
- Neither was immediately after CEW
- Autopsy findings were that deaths were unrelated*
- Paper not yet published, details not available

Bozeman et al

- No injury: 743 (77.2%) CI 74%,80%
- Mild injury: 216 (22.5%) CI 20%,25%
- Moderate: 2 (0.2%) CI .03%,.75%
- Severe: 1 (0.1%) CI 0%, .58%

- Summary:
 - No/mild injury: 99.7% CI 99.1%,99.9%
 - Mod/severe: 0.3% CI .06%,.91%
 - Severe injury: rhabdo, cerebral contusion after fall, epidural hematoma severe

Bozeman: worst case*

- Add the two deaths to the mod/severe
- Decrease the mild/mod by two
- None/mild: 957/962 99.5% (98.8,99.8)
- Mod/severe: 5/962 0.5% (0.2,1.2)

Calgary Police Service

Calgary, Alberta preliminary data

- January 2006- December 2007
- Prospective data collection
- All use of force above minor pain compliance
- N = 562 use of force incidents
- 89% of use of force subjects intoxicated with either alcohol or drugs

Calgary, Alberta: preliminary

- CEW use in 271/562
- No/mild injury: 231/271 85.2% (80.4,89.2)
- CEW subjects requiring hospitalization: <1%
 - baton: 3.2% subjects required hospitalization
 - empty hand physical control: 4% subjects required hospitalization
- No persons hospitalized with cardiac issues

Delirium

- a state of altered level of consciousness with impairment of cognition AND perception
- a symptom of an underlying disorder and is NOT a diagnosis of its own
- a continuum of behavior from obtunded to extreme agitation



Rosen, Concepts in Emergency Medicine

Excited delirium some of the underlying causes

- Psychiatric illness:
 - acute psychosis
 - Acute manic crisis (bipolar)
 - Not personality disorder unless drugs/ETOH
- Drug intoxication
 - Street drugs: coke, meth, PCP, alcohol, ecstasy, shrooms
 - “cocaine excited delirium” has acquired its own title
 - Rx drugs: Tricyclic antidepressant OD
 - OTC's: Gravol[®], Benadryl[®]
 - Not the same as malignant hyperthermia or neuroleptic malignant syndrome
- Combination of psych illness and drugs

Excited Delirium: some of the underlying causes

- Alcohol withdrawal
 - The true DT's
- Intracerebral processes
 - Bleeding: spontaneous or from trauma
 - Infection: encephalitis
 - Tumors
 - NOT from stroke generally
- Metabolic: "insulin shock", hyperthermia, thyroid storm
- Not the same as neuroleptic malignant syndrome or malignant hyperthermia

Fact patterns suggestive of a state of ED

- Known or suspected psychiatric illness
 - Especially schizophrenia or mania
- Known or suspected drug or ETOH intoxication
- Multiple previous calls to the same location/for the same individual
- Agitated, bizarre or destructive behavior

Clues that a state of ED exists, visible on arrival

- Bizarre, irrational behavior
- Constant yelling/screaming/"keening"
- Aggression toward inanimate objects
- Glass attraction
- Inappropriate attire: often naked or semi clothed

Clues encountered on contact with the subject

- Does not respond appropriately to police presence
- Insensitivity to pain mediated restraint:
 - hand to hand fights, OC spray, dogs, bean bags, Taser® in drive stun
- May have very hot skin
- May or may not sweat profusely, may seem profoundly dry

Characteristics of the struggle

- Apparent superhuman strength
 - Usually require multiple officers
 - Out of proportion with physical traits
- Violent struggling despite futility
 - Struggling against handcuffs, hobble >15 min
 - Facial smashing in vehicle
 - Kicking windows of vehicle*

What does that look like?



Recent Medical Editorial

- CMAJ e-pub May 01, 2008
 - “the company and its hired experts...have taught us about an emerging disorder called “excited delirium...”
 - “..tasers nevertheless appear to be the leading risk factor associated with sudden death due to excited delirium..”
- UK has changed terminology to “Acute Behavioral Syndrome”

Features of the death

- Occurs once subject is “successfully” restrained
- Occurs within ~5 minutes of subject becoming quiet
- First symptom of impending death is the death
- Virtually never* successfully resuscitated
- Occurs in police cars, cells, ambulances and hospitals

Victoria, April 2007

- 43 yo male
- Known crack abuser and known to be high on cocaine
- Agitated, combative and violent on sidestreet
- Throws passersby to the ground
- Breaking plateglass windows
- Random acts of violence
- VPD responds, Taser deployed x 2 in probe mode

Every method of restraint implicated in SCD

- 70's nightstick/lateral vascular neck restraint*
- 80's multiple officers, positional asphyxia
- 90's pepper spray
- 2000's: Taser[®]/CEW
- +/- concept of excited delirium in context

Victoria (ct'd)

- PAS responds: IM Midazolam 10 mg
- To ER: Haldol[®] 10 mg, another 20mg of IV Versed[®]
- Temp normal, CK normal
- Discharged to cells <6 hours later

- Why did this person survive?

Physiology of the collapse

- Metabolic acidosis – Hick et al
- Cocaine induced MI/arrhythmia
- Post exercise potassium shift
- Cocaine induced cardiomyopathy/ LVH
- Rhabdomyolysis
- Profound hyperthermia

Taser® research in healthy volunteers with ECG

- Levine et al: AEM 2005
 - Training of officers
 - ECG continuous during/after
 - No dysrhythmia
- Ho* et al: 2006
 - 66 volunteers with CEW and labs, ECG
 - 4/66 with signif med hx
 - No change in ECG's (n=33)
- Vilke et al, 2007
 - 32 healthy volunteers, single discharge
 - No abnormal ECG

Taser® and Arrhythmias

Year	Author	Journal	Subject	Number	CEW	Result	Industry
2006	Lakkireddy	JACC	Swine, Cocaine	5	X26 mod	Capture, no VF, higher thresh with coke	Yes
2007	Webster	IEEE	Swine		n/a	16mm VF	No
2007	Nanthakumar	JACC	Swine	6 pigs, 150 discharges	X26	Stim in 74/94 chest, none in nonthoracic	No
2007	Valentino	AEM	Swine	6	X26: 2x40sec	VF in all	No
2008	Lakkireddy	PACE	Swine	13, 5 pairings + drive stun	X26 and mod	Capture at Position 1, non thoracic = 0, no VF	Yes
2008	Ho	PACE	Human	37	X26 chest	No capture or VF on echo	Yes

Lakkireddy

- “VF could not be induced using the standard 5 sec Taser® discharge applied to the pig’s body surface area even at the most sensitive area tested”
- “With increasing distance of these electrodes from the heart, VF thresholds increased precipitously” ..even in those locations with one dart on the chest at the sternal notch.

Pig studies (3) unified in:

- Myocardial capture (extra beats) can be seen with perfect dart application on the chest
- Two studies have generated VF in pigs
- In 2/3 studies, application of the Taser without perfect dart placement never generated capture or Vfib

AICD

- Automatic Internal Cardiac Defibrillator
- Placed in people who are known to have sudden cardiac arrhythmias who are at high risk of sudden death
- Used in a very small subset of the general population
- Most AICDs can also act as pacemakers for the heart

Taser® deployment in subject with AICD

- Vancouver, BC 2005
- 51 year old female
- Hx of idiopathic VF x 5 years
- Tasered® x 1, 5 seconds
- AICD interrogated
- Device interpreted taser® artifact as VF and charged up but did not discharge
- Subject in sinus rhythm throughout taser®

Effect of a Taser shot to the chest of a patient With an implantable defibrillator. Haegeli et al Heart Rhythm 3(3) March 2006.

AICD: Lakkireddy 2007 (TI funding)

- *Do electrical stun guns (Taser X26) affect the functional integrity of implantable pacemakers and defibrillators? Dhanunjaya Lakkireddy, et al. Europace (2007) 9, 551-556.*
- Single pig with implanted devices
- No damage to pacemaker or AICD by the current
- AICD consistently read and responded to the Taser current pattern
- 5 seconds enabled AICD to begin charging

Taser and AICD

- *Duration of Discharge of Neuromuscular Incapacitating Device and Inappropriate Implantable Cardioverter-Defibrillator Detections. Colton, Nanthakumar et al. Circulation 2007; 115 e472-e474.*
- Published images to show recordings of Taser current and AICD tracing
- 5 second discharge allowed re read by the AICD and no shock if not committed
- 15 second discharge, AICD read as VF and discharged
- This data published in a separate paper in Europace 2008.

Sample death after Taser use

Prince George, July 2003

- Call for disturbance 17:16 hours, 11th ave
- Short summary of events:
 - Male acting erratically, threatens multiple people, now in a parkade
 - Numerous verbal commands, no response
 - Taken to ground, 3 members
 - OC spray, punches, kicks
 - Maximal restraint re: kicking
 - To detachment cell block

Prince George, July 2003

- Ongoing struggle
- Kicking while restraints going on
- Drive stun x2: one to back, one to L arm
- Ongoing struggle
- PAS called:
 - Unable to provide chemical restraint
 - Transport to hospital
- En route to hospital cardiac arrest (~25 min post Taser) and he died on July 22 at 09:05

From the narrative

Taser® and V fib*

- PACE report, January 2005
 - Pacing and Electrophysiology Journal
 - McDaniel and Stratbucker, swine study
 - Discharge of field taser® has extremely low prob of VF
 - Used modified weapon with higher capacitance
 - Document capture* but no VF
 - Dart on apex was more lateral than current studies
- Kim. NEJM letter: 353(9): 958 Sept 05
 - 14 yo, Vfib recorded ,successful resuscitation
 - Salient details missing

Taser® and Vfib

- Lakireddy JACC 48(4): 805-811 Aug 06
 - Taser International funding
 - IF chest placement: 6x energy of Taser® required to generate VF .
 - Cocaine increased threshold further
 - Capture seen: no BP change, no VF
 - No chest placement : to get VF required MUCH higher amps than Taser® can generate

CEW and heart arrhythmia

- Nanthakumar, JACC 2006;
- no industry funding, Toronto
- 150 discharges in 6 pigs
- thoracic placement was exact around heart
- Stimulation* of myocardium in 74/94 thoracic
- No stimulation if non thoracic
- When epi used: 13/16 had stim of myocardium : 1 VF and 1 VT

Valentino: AEM 2007

- *Taser discharges capture cardiac rhythm in a swine model. Valentino et al.*
- No industry funding
- Swine from 22-77kg
- U/S evaluation and ECG
- 6 experimental animals, X26 in 2 x 40 second chest applications
- 3 cases: VF on echo, to NSR within 5 sec
- 2 cases: sustained VF: one regained, one died
- 1 case: sustained VT then NSR in 15 seconds

Webster: Wisconsin, Swine study

- 2007 IEEE Report: Can Tasers directly cause VF?
- Determined distance necessary between dart and heart in pig model
- Dissected chest with conductive gel to mimic human chest
- Darts placed over RV and abdomen: 15-54 cm separation
- 17 mm dart distance generated VF

Lakkireddy et al 2008 (TI funded)

- *Cardiac Effects of Electrical Stun Guns: Does Position of Barbs Contact Make a Difference? Dhanunjaya Lakkireddy MD, et al .*
- used capacitance model for high current
- standard X26 for standard current
- 5 different probe pairing locations to simulate the worst case
 - SN PMI, SN infraum, SN supraum, cross chest, dorsal.

Lakkireddy results

- Did get 4.6:1 capture at position 1
- No VF with standard X26 discharge but lowest threshold for VF there with more current
- As per human studies, no chest application will not induce capture or VF
- Drive stun:
 - No VF anywhere
 - Capture with mid chest drive stun, no capture when right over apex or at SN

Ho et al: 2007/2008 (TI funded)

- *Ultrasound Measurement of Cardiac Activity During Conducted electrical Weapon Application in Exercising Adults. Jeffrey Ho MD, Donald Dawes, MD, et al*
- Presented at ACEP 2007, MEMC 2007 Italy
- PACE, April 2008
- 37 subjects
- chest application
- X26 x 15 seconds
- after exhaustive exercise
- Echo: No capture, no VF