TASERS and EMS

Separating Truth from Fancy
Raymond L. Fowler, M.D., FACEP

Associate Professor of
Emergency Medicine, Surgery, and Allied Health
and
Co-Chair of the Section on
EMS, Disaster Medicine, and Homeland Security

UT Southwestern School of Medicine
Dallas, Texas

Chief of Operations
The Dallas Metropolitan BioTel System
The Objective Questions:

1. What is a TASER all about?

2. Is it “safe” for “consumers”?

3. What do WE do with “consumers” who have been “tased”?
How do we best protect life and property when those we serve may be impossible to control.
Do we HAVE to get hurt
to do our jobs?

...is it required by
our oath to serve?
Video 1
Crazy Guy in Jail
The number of public health and welfare providers who have been injured during service is enormous.
It is an odd thing that the very performance of our jobs may threaten our health and livelihood.
Not unlike, interestingly, what will happen if a pandemic influenza outbreak ever comes to our country, and medics have to respond to the scene of patients with illnesses that could be fatal to the medics.
We are now called out to manage the unmanageable

“Toxic Resistance”
The epidemic of agitated delirium due to substance abuse is a shameful tale of a scourge to the public welfare.
Delirium
A question for you…

• Does a citizen who has broken the law and become non-compliant with public safety lose personal freedom?

• Does that individual risk facing progressive escalation of attempts to stop that person from fleeing?

• If a person becomes psychotically agitated with “uppers”, does that person assume a risk to health by being restrained?
Video 2
Guy with knife
Another question?

Is it in your job description that you **HAVE** to be at risk to become Hepatitis C infected by a psychotic cocaine overdose while holding him down to start an I.V.?
Let’s review the essential aspects of the TASER
DEVELOPMENT

Began in the Early ’70’s with (relatively) primitive technology

Further study ensued over the last 20+ years

How much current?
The Basic Goal

Find a technology that would immobilize any patient at any time with a minimal amount of harm.

Depolarizing Current
High frequency electrical currents tend to stay near the surface of a conductor. Hence, the output of the Advanced Taser is believed to stay near the surface of the body in the skin and muscle tissue and does not penetrate into the internal organs.
This is known as a Faraday shield.

The electrical delivery of the Taser, and thus its injury potential, are likely to be different from other conventional modes of electrical injury.
The threshold for ventricular fibrillation is thought to be around 50-100 mAmps.

The maximum intensity of a U.S. household current is 240 Amps.
So, the design had to be carefully done
SHOCKING SELF DEFENSE

The use of Tasers by thousands of law enforcement agencies has already drawn controversy. Now, a new version of these devices that deliver jolts of electricity instead of bullets is being sold to civilians.

HOW IT WORKS

1. Top dart hits where gun is pointed; second dart hits slightly lower

Range: 15 ft.

2. The civilian version can shoot in three consecutive 10-second bursts of 26-watt electricity. The police version fires a 5-second burst. Both make the target’s muscles contract and overcomes the nervous system. Most people collapse.

TASER X26C

20-40
ID tags are dispersed when a Taser is fired, making the user traceable and discouraging misuse

Electrical wires carry a "shape pulse" that delivers 17 pulses per second for first 10 seconds, then 10 pulses per second for the next 20 seconds

Gas cartridge uses 1,800 psi compressed nitrogen to launch darts

Lithium battery pack replaces eight AA batteries that required a long, heavy grip in earlier model

Physical effects

- Works by "electro-muscular disruption" a contraction of muscles throughout the body
- Causes temporary incapacitation but is said to have no permanent effect
- Darts do not have to penetrate flesh to work

Length: 6 in.
Width: 1.3 in.
Weight: 7 oz.
Cost: $999

Darts fire at 160 to 180 feet per second, penetrating clothing and skin

Source: Taser International
The M26 Advanced Taser delivers a sequence of approximately half sine wave current pulses, each having a peak amplitude average of 2.1 milli Amps and a duration of about 11 microseconds.
The peak voltage output of the device is considered to be as high as 50,000 Volts.
The peak power of each pulse is estimated to be 324,000 Watts. The average power being 26.4 Watts, each pulse having an energy of 1.76 Joules.
The differences in the two numbers are that the joules (and the voltage) depend on the load, or resistance.

- If there is no load, tasers deliver 0.36 Joules per pulse.
- Under typical load (down the wires, through skin, body, etc.), it is only 0.07 Joules per pulse.

It is only 0.07 Joules per pulse under load.
50,000 volts
but
only 0.07 joules
against load
The resistance that the Taser circuit sees when it applies its current (electrons x voltage) against the wires, contacts, and the patient's body.
A Taser is technically “DC”. Pulses are sent at 19 per second. Typical 60 Hz for AC.
0.07 Joules/pulse
x 19 pulses/second
= 1.3 Joules/second

A defibrillator fires
200 joules/0.4 seconds
= 500 Joules/second

Taser = 1.3 Joules/Second
Defib = 500 Joules/Second

Defib delivers
400 times the energy of a Taser
200 joules/0.4 seconds

= 500 Joules/second
The taser gun fires darts that release an electric charge temporarily paralysing the target.
WARNING

Electronic Control Device
• Can temporarily incapacitate target.
• Can cause injury.
• Obey warnings, instructions and all laws.
• Comply with current training materials and requirements.
• See www.TASER.com.
## Specifications

1. **Output characteristics:**
   - Wave form: Complex shaped pulse
   - Pulse rate: 19 PPS
   - Pulse duration: 100 microseconds
   - Peak open circuit arcing voltage: 50,000 V
   - Peak loaded voltage: 1,200 V
   - Current: 2.1 mA average
   - Energy per pulse:
     - Nominal at main capacitors: 0.36 joules
     - Delivered into load: 0.07 joules
   - Power rating:
     - Nominal at main capacitors: 7 watts
     - Delivered into load: 1.3 watts

2. **Power source:** Digital Power Magazine (DPM)

3. **Temperature range:** -4 °F [-20°C] to: 122 °F [50 °C]

4. **Relative humidity:** 15% to 80%

5. **Housing:** High impact polymer

6. **Patent:** U.S. D508,277 D504,489 and other patents pending
DEPLOYMENT WARNINGS

To minimize the risk of injury during or from deployment, follow these guidelines:

**Deployment Safety Procedures**

**Avoid Weapons Confusion.** Handguns have been confused with TASER devices. Learn about the differences in physical feel and holsters characteristics between the TASER device and your handgun. This will allow you to confirm device identity under stressful situations. Follow agency’s equipment carrying guidelines and training.

**Select Preferred Target Areas.** The preferred target areas are the subject’s torso (center mass) or legs. Avoid intentionally aiming a TASER device at the head or face without justification.

**Avoid Sensitive Areas.** Significant injury can occur from TASER device deployment into sensitive areas of the body such as the eyes, throat, or genitals—avoid intentionally targeting these areas without justification.

**Avoid Known Pre-Existing Injury Areas.** When practical, avoid deploying a TASER device at a known location of pre-existing injury (e.g., avoid targeting the back for persons with known pre-existing back injuries, avoid targeting the chest area on persons with a known history of previous heart attacks, etc.). These injuries may be provoked by such deployment.

**Beware—TASER Device Can Ignite Explosive Materials, Liquids, or Vapors.** These include gasoline, other flammables, explosive materials, liquids, or vapors (e.g., gases found in sewer lines, methamphetamine labs, and butane-type lighters). Some self-defense sprays use flammable carriers such as alcohol and could be dangerous to use in immediate conjunction with TASER devices.

**Reload and Deploy.** If a TASER device application is ineffective in achieving the desired effect, consider reloading and redeploying or using other force option(s), according to approved training and policy.

**Plan Deployment Backup.** No weapons system, tool, or technique is effective 100% of the time. Consider acceptable options, alternatives, and backup plans in case of ineffective deployment when deploying, activating, or otherwise using a non-lethal weapon, including TASER devices.

**Control and Restrain Immediately.** Begin control and restraint procedures as soon as it is reasonably safe to do so in order to minimize the total duration of exertion and stress experienced by the subject. User should avoid touching the probes and wires and the areas between the probes during TASER electrical discharge.

**Deployment Health Risks**

**Sudden In-Custody Death Syndrome Awareness.** If a subject is exhibiting signs or behaviors that are associated with Sudden In-Custody Death Syndrome, consider combining use of a TASER device with immediate physical restraint techniques and medical assistance.
The effect:

- Diffuse muscle depolarization

"Plywood"

Literally, stiff as a board
What leads people to the point where they get tased?
Video 3
Drunk on Road
People in excited delirium lose all feedback mechanisms that tell them to slow down and relax.
Picture the amount of activity you expend when you go out to run to exercise.

You get to a point where you say "OK, this is fast enough" and don't push yourself.
Then picture if you are chasing a suspect.

You will push yourself past this point, until you are physically exhausted, then you will stop (or at least slow down).
Imagine being chased by a 1000 pound gorilla.

You will push yourself to the point where your body will begin to fail, muscles will try to lock up, you can't breath any faster.
Take a sedentary person, overweight, and then run him WILDLY PLUS a bunch of hits from an epinephrine inhaler.

Arrhythmias
And, possibly sudden death....
The people doped on cocaine or meth don't even realize when they hit this point. But, they reach this point gradually.
Activity Level

Fitness
running

Suspect
chase

Chased
by 800lb
gorilla

Excited
delirium

X
This causes unexpected electrolyte changes.

The danger comes in when they get placed in custody.
They go from this extreme energy expenditure to nothing, causing (theoretically) massive electrolyte shifts that result in cardiac arrest.
Maybe a better approach is to let them keep their activity up...

...and bring it down slowly.

Jeff Metzger, MD, FACEP
Senior EMS Fellow
UT Southwestern
Video 4
Gal in Jail
Do our obligations change in any way to a patient that has been “tased”?
In many cases, yes...

Patients with AD who have been exerting greatly are at greater risk of adverse outcomes.
What must be performed on ALL Tased Patients?

An Initial Assessment
Scene Survey/Mechanism/# pts.

LOC/Airway/Cspine

Respiratory Rate and Labor

Pulses R & Q, N & W
Skin CMT/CRT/External Bleeding

Neck appearance, JVD, Trachea

Chest appearance, BS, HT

Quick survey of abdomen, pelvis, extremities, and back
Scene Survey/Mechanism/# pts.
LOC/Airway/Cspine
Respiratory Rate and Labor
Pulses R & Q, N & W
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Neck appearance, JVD, Trachea
Chest appearance, BS, HT
Quick survey of abdomen, pelvis, and extremities

Reveals threats to Basic Physiology

. . .the vital elements of the Primary Survey
What all could be wrong?
Signs of Shock

Early
- Weak, thirsty, lightheaded
- Pale, then sweaty
- Tachycardia
- Tachypnea
- Diminished urinary output

Late
- Hypotension
- Altered LOC
- Cardiac arrest
- Death
Central Cyanosis
Rhythm Strip Interpretation
A Tachycardia may well be observed
...or tachyarrhythmias
May induce arrhythmia
A patient in arrest would require immediate resuscitation utilizing AHA Guidelines.
…keeping in mind the possibilities of severe metabolic acidosis, hyperkalemia, or hypothermia
Adult volunteers

No significant change in electrolytes, BUN, creatinine

Increase in bicarb and CK levels at 16 and 24 hrs, increase lactate after event that was gone at 16 hrs, elevated troponin 0.6 in one
A dart to the heart produces ventricular fibrillation in pigs…

…only a TINY probability in humans
The ACC has stated that the pig model is insufficiently similar to humans to extrapolate the results.
To the Editor: The question of the safety of the use of "stun guns" by law-enforcement agencies has been raised in the news.¹ Deaths after discharges from such devices (Tasers) have been reported, although no definite causative link between death and the use of a stun gun has been made.²,³

An adolescent was subdued with a Taser stun gun and subsequently collapsed. Paramedics found the adolescent to be in ventricular fibrillation (Figure 1A) and began performing cardiopulmonary resuscitation within two minutes after the collapse. After four shocks and the administration of epinephrine, atropine, and... [Full Text of this Article]
October 2006 PEC
Taser-related deaths
75 cases, 37 with autopsy

- All men, 18 – 50 y/o
- 54% CV disease
- Illegal drugs 78%
- Agitated delirium 76%
- Taser-related death in 25% though restraints played role
Physiology

Oxygen -> lungs -> alveoli -> blood

CO₂ breath

Oxygen muscles + organs

CO₂ lungs

CO₂ blood

energy

Oxygen + Glucose cells
Acidosis, lactate, electrolytes, muscle enzymes, and other factors in the blood of Sus scrofa following repeated TASER exposures.

Jauchem JR, Sherry CJ, Fines DA, Cook MC.

Air Force Research Laboratory, Human Effectiveness Directorate, Directed Energy Bioeffects Division, Brooks City-Base, Texas 78235, USA. james.jauchem@brooks.af.mil

Repeated exposure to electro-muscular incapacitating devices could result in repetitive, sustained muscle contraction, with little or no muscle recovery period. Therefore, rhabdomyolysis and other physiological responses, including acidosis, hyperkalaemia, and altered levels of muscle enzymes in the blood, would be likely to occur. Experiments were performed to investigate effects of repeated exposures of TASER International’s Advanced TASER X26 on muscle contraction and resultant changes in blood factors in an anaesthetized swine model. A total of 10 animals were used. Six swine were exposed for 5 s, followed by a 5-s period of no exposure, repeatedly for 3 min. (In five of the animals, after a 1-h delay, a second 3-min exposure period was added.) The remaining four animals were used for an additional pilot study. All four limbs of each animal exhibited contraction even though the electrodes were positioned in areas at some distances from the limbs. The degree of muscle contraction generated during the second exposure period was significantly lower than that in the first exposure series. This finding was consistent with previous studies showing that prolonged activity in skeletal muscle will eventually result in a decline of force production. There were some similarities in blood sample changes in the current experiments with previous studies of muscular exercise. Thus problems concerning biological effects of repeated TASER exposures may be related, not directly to the “electric output” per se, but rather to the resulting contraction of muscles (and related interruption of respiration) and subsequent sequelae. Transient increases in hematocrit, potassium, and sodium were consistent with previous reports in the literature dealing with studies of muscle stimulation or exercise. It is doubtful that these short-term elevations would have any serious health consequences in a healthy individual. Blood pH was significantly decreased for 1 h following exposure, but subsequently returned toward a normal level. Leg muscle contractions and decreases in respiration each appeared to contribute to the acidosis. Lactate was highly elevated, with a slow return (time course greater than 1 h) to baseline. Other investigators have reported profound metabolic acidosis during restraint-associated cardiac arrest. Since restraint often occurs immediately after TASER exposure, this issue should be considered in further development of deployment concepts. On the basis of the results of the current studies, 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).
Effects of cocaine intoxication on the threshold for stun gun induction of ventricular fibrillation.


Cleveland Clinic Foundation, Cleveland, Ohio, USA.

OBJECTIVES: This study sought to assess cocaine's effects on Taser-induced ventricular fibrillation (VF) threshold in a pig model. BACKGROUND: Stun guns are increasingly used by law enforcement officials to restrain violent subjects, who are frequently intoxicated with cocaine and other drugs of abuse. The interaction of cocaine and the stun gun on VF induction is unknown. METHODS: We tested five adult pigs using a custom device built to deliver multiples of standard neuromuscular incapacitating (NMI) discharge that matched the waveform of a commercially available electrical stun gun (Taser X-26, Taser International, Scottsdale, Arizona). The NMI discharges were applied in a step-up and step-down fashion at 5 body locations. End points included determination of maximum safe multiple, minimum VF-inducing multiple, and ventricular fibrillation threshold (VFT) before and after cocaine infusion. RESULTS: Standard NMI discharges (x1) did not cause VF at any of the 5 locations before or after cocaine infusion. The maximum safe multiple, minimum VF-inducing multiple, and VFT of NMI application increased with increasing electrode distance from the heart. There was a 1.5- to 2-fold increase in these values at each position after cocaine infusion, suggesting decreased cardiac vulnerability for VF. Cocaine increased the required strength of NMI discharge that caused 2:1 or 3:1 ventricular capture ratios at all of the positions. No significant changes in creatine kinase-MB and troponin-I were seen. CONCLUSIONS: Cocaine increased the VFT of NMI discharges at all dart locations tested and reduced cardiac vulnerability to VF. The application of cocaine increased the safety margin by 50% to 100% above the baseline safety margin.

PMID: 16904553 [PubMed - indexed for MEDLINE]
Barb Removal:

Paramedics are qualified
(as are most people)

Beware of face, hands, feet, and genitalia
Taser dart to the eye produces a terrible result

“Vitreoretinopathy”
Be careful to avoid the eyes
At what point is the sedated A.D. patient safe to be around?
Safety for Public Safety
BENEFITS—Deputies at the Orange County Sheriffs Office in Florida have found the TASER® energy weapon to be so effective, they deploy TASER devices over 3 times more often than chemical sprays. In fact, since the TASER devices were first deployed, pepper spray deployments have dropped by 50%, and lethal force incidents have fallen by 78%.
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Dramatic lowering of Officer injury rates with TASER over spray and baton
Is that a reasonable way to judge a portion of the impact of the implementation of these devices?
Absolutely
Video 6
Bull
get your own personal taser

the world's biggest electronics convention is underway in las vegas this week.
typically companies are pushing things like the latest in tvs, computers, and other entertainment or communication products.
but this year there's a high-tech weapon for self-defense.
Be suspicious for occult or obvious injury
JVD is always abnormal
Our care is challenging
The requirement for professionalism in EMS continues to grow.
The scope and breadth of your practice will be limited only by your imagination.