Cardiovascular Safety Profile of Electrical Stun Guns (TASER®): Impact of Point of Delivery on Ventricular Fibrillation Thresholds

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Background & Objective

The electrical stun guns, a.k.a. neuromuscular incapacitation devices (NMIDs), are increasingly used by law enforcement personnel over traditional lethal and non-lethal weapons.
*A frequently employed model (TASER X-26, TASER® International, Scottsdale, AZ) delivers high voltage-low current electrical energy to the body, causing transient neuromuscular disruption with incapacitation.
*Reports suggest an association between NMIDs and nearly 100 in-custody deaths.

In this study we assessed the vulnerability for VF induction by a NMID at varying locations on the body surface in a pig model.

Methods

• Animals: A total of 13 anesthetized adult pigs (length 104.7±20.3 cm, weight 34.4±6.95 kg and a chest circumference 67.2±4.0 cm)
• Stun gun: TASER® X26 is a 26-watt pistol-like device that shoots two tethered darts and delivers up to 6000 volts (typical output about 1500 volts) of peak electrical potential at 19 rapid pulses per second over 5 seconds. Arcing voltage is strictly "open-circuit".
• The average net current is < 2 mA & Energy per pulse is about 70 mJ with an output power ~ 1.5 W ~ 19 pps • 70 mJ.

• Experimental protocol: VF vulnerability to application of NMI discharges at multiples of standard outputs@ 5 paired-dart positions Sternal notch (SN) – point of maximum cardiac impulse (PMI) (Position-1), SN – supra-umbilical region (Position-2), SN – infra-umbilical region (Position-3), side to side across the chest (Position-4) & upper to mid posterior region (Position-5).

• Endpoints: • Minimum ventricular fibrillation induction multiple (MinVFIM) lowest shock multiple that induced VF at least once.
• Maximum safe multiple (MaxSM) the highest shock multiple that could be applied 3 times without induction of VF.
• Ventricular fibrillation threshold (VFT) was defined as the average of these two values.
• Ventricular capture was quantified as the ratio of pulses of the NMI discharge to the number of captured beats.

Results

Study end points at the tested positions: VF was never induced with the standard x1 NMI application at any of the 5 positions.

• MinVFIM, MaxSM, and VFT were the lowest when the darts were applied in the axis of the heart with one dart at the PMI (position-1). The highest values were seen when NMID were applied furthest away from the heart on the dorsum (position-5). The values of the end points at position-2, position-3 and position-4 were progressively higher and ranged in between those of position-1 and position-5.

Conclusions

Even with the worst-case locations, with barbs plunged fully towards the heart, we were never able to induce ventricular fibrillation in 34 kg (76 lb) pigs.