Journal of Forensic and Legal Medicine 53 (2018) 51–57

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/yjflm

The neurocognitive effects of a conducted electrical weapon compared to high intensity interval training and alcohol intoxication - implications for Miranda and consent

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ARTICLE INFO

Keywords:
TASER
Conducted electrical weapon
CEW
Neurocognitive
Alcohol intoxication
High intensity interval training
Exertion
Miranda
Consent
Use-of-force

ABSTRACT

While the physiologic effects of conducted electrical weapons (CEW) have been the subjects of numerous studies over nearly two decades, their effects on neurocognitive functioning, both short-term and long-term, have only recently been studied. In a 2014 study involving use-of-force scenarios, including a CEW scenario, we found that there was a decline in neurocognitive performance immediately post-scenario in all groups; however this effect was transient, of questionable clinical/legal significance, not statistically different between the groups, and, returned to baseline by one hour post-scenario. Two subsequent studies by other authors have also found transient neurocognitive effects in the immediate post-exposure period; however, in one study, the effect was greater in one measure (of 5) for the CEW compared to exertion, and the authors suggested that this effect could have implications for the Miranda waiver obtained before custodial interrogation as well as consent.

In our current study, we compared the neurocognitive effects of an exposure to a CEW to another exertion regimen, as well as to alcohol intoxication given the latter has significant established case law with regard to the Miranda waiver and consent. Such a comparison may offer more insight into the clinical/legal significance of any measured changes. As with the prior studies, the neurocognitive performance decrements of the CEW and exertion regimens, found only in one measure in this study (of three), were transient, and here, non-significant. Only alcohol intoxication resulted in statistically significant performance declines across all measures and these were persistent over the study period. Given that the neurocognitive changes associated with the CEW were non-significant, but were significant for alcohol intoxication, and given that current case law does not use intoxication as a per se or bright line barrier to Miranda and consent, our results do not suggest that a CEW exposure should preclude waiving of Miranda rights or obtaining consent.

1. Introduction

While conducted electrical weapons (CEW) have been the subjects of numerous studies over nearly two decades, only three recent studies have examined their effects on neurocognitive functioning. This prior void in the literature has resulted in the extrapolation of findings from the electrical injury literature from residential and commercial power sources in a number of civil and criminal actions. Despite vastly different energies compared to the CEW, this high-energy literature has been used to make claims regarding the effects of CEWs that include an inability to follow an officer's commands, perform a field sobriety test, or understand Miranda warnings post-CEW exposure due to short-term neurocognitive impairment as well as long-term neurocognitive functioning deficits.[1–5] In U.S. v Mack, Mack complained that the use of the CEW "rendered him incapable of understanding his rights under Miranda or of effectively waiving those rights" in an effort to suppress statements he made to officers in the immediate post-arrest period. The court ruled against Mack in part since he did not present evidence "indicating that administration of a [CEW] renders the recipient incompetent for any amount of time".[5]

In 2014, Dawes et al. conducted the first detailed study in the area comparing the neurocognitive effects of a CEW to several different use-of-force scenarios (sprint/flight, fight, K-9 bite, and pepper spray) using a well-established computer-based neurocognitive metric.[6] Performance decrements were observed immediately following all of the scenarios with a return to baseline performance by one hour.

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https://doi.org/10.1016/j.jflm.2017.11.001
Received 16 July 2017; Received in revised form 6 November 2017; Accepted 12 November 2017
Available online 14 November 2017
1752-928X/

Importantly, there was no statistical difference between the scenarios suggesting a generalized, transient stress response for all the scenarios that is not specific to the CEW. Furthermore, it was not clear that the measurable neurocognitive changes were clinically or legally important. In a later study, White, et al. administered a cognitive battery to subjects receiving a CEW training exposure. Deficits were observed at 5 min post-exposure that had resolved upon repeat testing at 24 h.[7] There was not a comparison group in this study. In a follow up study by Kane and White, using college student volunteers, greater performance decrements were observed on a single measure (of five administered), the Hopkins Verbal Learning Test (HVLT), following CEW exposure in comparison to exertion involving 30-s of punching a heavy bag. Performance returned to baseline by repeat testing at one hour[8] While all three studies showed no long-term neurocognitive deficits, and two studies showed a return to baseline within one hour (the first White study only measured at 5 min and 24 h with no assessment points in between), Kane and White concluded that their findings suggested that a CEW exposure could affect a suspect's ability to waive his Miranda rights and give consent in the 60 min after a CEW exposure.

The issue of generalizing from a transient decrement in one of five measures aside, there is the question of the appropriateness of extrapolating CEW neurocognitive battery results to the more general legal issues of waiving Miranda rights and obtaining consent. There is significant and well-established case law in the area of alcohol intoxication and the Miranda waiver as well as obtaining consent. Therefore, in the current study we compare the neurocognitive effects of an exposure from a TASER® (TASER International, Inc, Scottsdale, AZ) X2™ CEW, to those observed from a high intensity interval training (HIIT) regimen (to maintain some consistency from prior studies), and alcohol intoxication using a well-established neurocognitive metric administered serially over 85 min. We hypothesized that: 1) there would be a change in the neurocognitive performance after the CEW exposure, as with prior studies, but that it would rapidly return to baseline, 2) the changes in performance would be no greater than the exertion regimen, and 3) that this change would be less in both magnitude and duration than that for alcohol intoxication, particularly higher levels of intoxication. The comparison of a CEW exposure to alcohol would allow for some insight into the clinical/legal significance of any observed neurocognitive battery changes. To our knowledge, this is the first study comparing the neurocognitive effects of a CEW to alcohol intoxication.

2. Methods

2.1. Participants

This was a prospective, observational study of a convenience sample of adult (ages 18 or older) law enforcement officers, correctional officers, security officers, and civilians participating in a CEW training exercise. The study was conducted at TASER International. In accordance with prior conflict of interest procedures, an independent physician observer from Hennepin County Medical Center (Minneapolis, MN) with no affiliation with TASER International was present during all phases of the study. An independent statistician, with no affiliation with TASER International except for being contracted specifically for the data analysis for this study, performed all data analysis. The independent physician observer also reviewed the data analysis. The institutional review board and conflict of interest committee for the Minneapolis Medical Research Foundation (Minneapolis, MN) reviewed and approved the study.

Subjects provided informed consent and completed a screening questionnaire that included demographic data and a basic past medical/surgical history that was reviewed prior to participation in the study. If there were concerns regarding a subject's ability to safely participate in an assigned study arm, a study physician reviewed the questionnaire with the subject and the subject made the final determination for inclusion or exclusion based on that review.

Exclusion criteria for the CEW and HIIT arms were any injury or other physical condition that might make participation unsafe. Exclusion criteria for the alcohol arm included any history of alcohol or drug abuse, concern for pregnancy, and age < 21.

2.2. Interventions

Subjects enrolled in one of five study arms: 1) a 5-s TASER X2 CEW probe-mode exposure to the back, 2) a high intensity interval training routine (HIIT), 3) “low” alcohol intoxication with a target portable breath test (PBT) reading of 0.08–0.15 g/210 L (estimation based on the commonly-used Widmark formula), 4) “high” alcohol intoxication with a target PBT reading of 0.15–0.20 g/210 L, and 5) a control group. Assignment to the study arms was based on convenience with consideration to logistical factors including a desire to keep the study arms equal as well as availability of subjects for the scheduled study interventions. Study subjects were specifically recruited for the two alcohol arms due to the need for subject advanced planning (e.g., off work), a designated driver to and from the testing location, as well as eating instructions, meeting important exclusion criteria, and the need to make it completely voluntary. Otherwise, the subjects were not aware of the study arm to which they were assigned until they showed up for the study and they were not allowed to volitionally change arms after being assigned (although they could withdrawal at any time).

CEW. Subjects were provided safety glasses and placed supine with or without a shirt depending on subject preference on a padded training mat. A TASER instructor shot subjects in the back from above on at ladder at a distance of 75 inches (191 cm) with an off-the-shelf TASER X2 CEW using standard 25-foot (8-m) cartridges and XP (13 mm) probes (darts). While the distance between the probes was not measured, it would be expected that this would result in a probe spread of 10–11 inches (25–28 cm) given the 8-degree offset between the probes. The CEW was allowed to run for the standard 5-s duty cycle that results from one trigger pull. The probe wounds were dressed with adhesive bandages.

HIIT. Subjects completed a 90-s high intensity interval training exercise regimen. The regimen consisted of 10 steps/jumps onto an 8-inch (20 cm) plyometric box, followed by 10 ground-to-overhead lifts of 15-pound (7 kg) dumb bells, followed by 10 strikes on a large tractor tire with an 8-pound (3.6 kg) sledge hammer with the stations repeated in order until the 90 s elapsed. Subjects were encouraged to give maximal effort by voice encouragement during the regimen.

Alcohol Intoxication. Subjects were instructed to not eat for 2 h prior to arrival since this can affect alcohol absorption. Subjects were given a pre-determined number of ounces of 80-proof (40% alcohol by volume) liquor with or without a mixer of their choice over 45 min to 1 h based on the widely-used Widmark formula. For reference, a standard “shot” or “jigger” is 1.5 ounces, or approximately 44 mL. The subjects were divided into a “low” alcohol intoxication group with a target PBT reading of 0.08–0.15 g/210 L and a “high” alcohol intoxication group with a target PBT reading of 0.15–0.20 g/210 L. After drinking the prescribed number of ounces (support personnel served drinks and monitored their progress during the “drinking period” to set the pace) or reaching the time limit, the subjects completed an abbreviated standardized field sobriety test (SFST) performed by a certified tester. The test consisted of three components: horizontal gaze nystagmus, walk and turn, and one-legged stand. At 10 min after completion of the “drinking period”, subjects had their blood alcohol content (BAC) estimated with the PBT (Alco-Sensor FST, Intoximeters, St. Louis, MO). The 10-min delay was recommended by the test device manufacturer to ensure accurate readings. During this 10-min period, the subjects were observed to ensure they did not eat or drink.

Control. Subjects in this arm had 10 min of “no intervention.” They were provided a break room where they could relax while waiting for the neurocognitive testing.