Shocked But Not Surprised: The Philly Cardioversion

Gillian Naro, MD, MEd
*Thomas Jefferson University*, gillian.naro@jefferson.edu

Naman Upadhyay, MD
*Thomas Jefferson University*, naman.upadhyay@jefferson.edu

Emilie Thompson, MD
*Thomas Jefferson University*, emilie.thompson@jefferson.edu

Tudor Sturzoiu, MD
*Thomas Jefferson University*, tudor.sturzoiu@jefferson.edu

Follow this and additional works at: [https://jdc.jefferson.edu/tmf](https://jdc.jefferson.edu/tmf)

Part of the [Internal Medicine Commons](https://jdc.jefferson.edu/tmf)

Let us know how access to this document benefits you

**Recommended Citation**

Naro, MD, MEd, Gillian; Upadhyay, MD, Naman; Thompson, MD, Emilie; and Sturzoiu, MD, Tudor (2022) "Shocked But Not Surprised: The Philly Cardioversion," *The Medicine Forum*: Vol. 23, Article 10.

DOI: [https://doi.org/10.29046/TMF.023.1.009](https://doi.org/10.29046/TMF.023.1.009)

Available at: [https://jdc.jefferson.edu/tmf/vol23/iss1/10](https://jdc.jefferson.edu/tmf/vol23/iss1/10)

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning (CTL)](https://ctl.jefferson.edu). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in The Medicine Forum by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: JeffersonDigitalCommons@jefferson.edu.
INTRODUCTION

Neuromuscular incapacitating devices, colloquially known as 'tasers', are typically used by police and security personnel as a non-lethal way to subdue combative assailants. Unfortunately, there are times in the hospital when patients can become assailants, thus potentially necessitating the use of tasers to ensure the safety of staff and other patients. Tasers come in several varieties. However, those typically used by law enforcement have a 50,000-V capacity and deliver 0.36 - 1.76 Joules of energy per pulse, at a rate of ~20 pulses per second, via two barbed projections. This leads to incapacitation of the assailant via the induction of fused muscle contractions that preclude coordinated neuromuscular inputs, thus inducing a near-tetanic state. In medicine, we often use electricity in a coordinated manner to convert dangerous cardiac arrhythmias back to normal sinus rhythm. In this case, we discuss how a patient who was admitted to the hospital in a sustained arrhythmia, became an assailant. A taser was used to subdue him, and we will examine how this theoretically may have impacted his arrhythmia.

CASE

A patient with a past medical history of advanced heart failure with reduced ejection fraction of 10% secondary to methamphetamine use was admitted to the medical intensive care unit for severe COVID-19 infection resulting in hypoxic respiratory failure requiring intubation. His acute respiratory condition stabilized, and he was liberated from the ventilator. His oxygen status continued to improve as he was weaned to 2L nasal cannula, and he was transferred to a general medicine telemetry service.

His hospital course was further complicated by suspected in-hospital use of methamphetamines resulting in atrial fibrillation with rapid ventricular response with rates in the 150s. The patient reported feeling "bad", and he was noted to be diaphoretic and agitated. He was started on a digoxin infusion and given intravenous diuresis. As he experienced subjective improvement with down trending heart rates, he asked to leave the hospital against medical advice (AMA). On examination of the patient, he was unable to express the risks of leaving the hospital and foregoing additional medical interventions. With psychiatry input, patient was deemed to lack capacity to leave AMA.

Patient then became angered, decannulated his intravenous lines, removed his telemetry strips, and attempted to leave the hospital room. He became very aggressive with threats of violence to the medical staff, so security was contacted. His condition visibly appeared to deteriorate as he was in clear extremis, diaphoretic, and weak. Even his screaming became more tired and hoarse. Finally, after an hour of negotiation, the patient lunged at the provider, requiring the security officer to react by activating his taser and delivering a shock. He was then injected with 5mg of intramuscular haloperidol and placed in four-point restraints. The team was hopeful that the delivery of electricity to his chest may have restored sinus rhythm, but the patient remained in atrial fibrillation when placed back on telemetry.

DISCUSSION

It has been previously posited that taser devices pose minimal cardiac threat because of the depth of tissue that must be penetrated to affect the heart, the relative intensity of electrical energy required to activate cardiac muscle as opposed to skeletal muscle, and the different electric pulse widths required to activate cardiac as opposed to skeletal muscle. There has been extensive original research assessing the cardiac and even neurologic risk associated with taser devices since their development, and this has also been reviewed in the literature.

Interestingly, it does appear that taser shocks can influence cardiac activity, as was demonstrated in a previous report outlining a pacemaker interrogation that revealed the induction of rapid ventricular conduction in a patient following a taser shock. Additionally, we were able to locate one case report of atrial fibrillation induced in a patient with no history of atrial fibrillation, normal electrolytes, and a structurally normal heart following the application of a taser shock. In the case of our patient, there was a fleeting hope among the care team that the taser shock could have
successfully restored sinus rhythm via electrical cardioversion, but this was revealed to not be the case after he was back on telemetry after being subdued.

There are many reasons why this might be, but it seems reasonable that inherent differences among different brands of tasers may affect the potential of each unit to influence myocardial conduction. Further, various areas on the human body where this shock could be applied, it stands to reason that there are many potential physiologic effects of a taser shock that will not be experienced. Additionally, the actual energy delivery per taser shock is quite low, at around an average of 1 J per pulse among different units, and it is difficult to quantify what additive effect the many shocks delivered per second may have on myocardial conduction. Research by Richard et al reports only a 22% success rate with 50 J in external cardioversion in atrial fibrillation, which is significantly higher than the average J delivered per shock from a taser. In a patient with severe cardiomyopathy, even a coordinated shock from a dedicated defibrillator may not be successful in restoring sinus rhythm, and this is not entirely surprising that a taser-mediated shock, which we fondly refer to as a “Philly Cardioversion”, was unable to restore sinus rhythm in this patient.

Although the authors would certainly prefer that no additional humans undergo a taser shock, further observation of the incidence of the resolution of arrhythmias in the setting of taser shocks will continue to elucidate the potential of these enforcement tools to influence cardiac activity. Since tasers are designed to provide a non-lethal shock, their mechanics would ideally have very low risk myocardial involvement.
Naro, MD, MEd et al.: Shocked But Not Surprised: The Philly Cardioversion

"Just Surgeons" – Heping Sheng, MD