

## Response to Letters Regarding Article, "Sudden Cardiac Arrest and Death Following Application of Shocks From a TASER Electronic Control Device"

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## Response to Letters Regarding Article, “Sudden Cardiac Arrest and Death Following Application of Shocks From a TASER Electronic Control Device”

I thank the authors of the Letters to the Editor for their interest in my article. As Drs Nanthakumar and Waxman indicate, the left ventricular epicardium becomes inexcitable during ischemia (such as would be provoked by ventricular fibrillation [VF]), whereas Purkinje fibers and endocardial muscle remain fully responsive.<sup>1</sup> In fact, one can record asystole in some ECG leads when VF is actually still present in others.<sup>2</sup> I agree that determining the response to a TASER shock that induces rapid capture and VF is critical. I am glad they think the article sheds light on a complicated issue.

Drs Vilke, Chan, and Karch question the “clinically healthy” wording I explained in a published correction for my article<sup>3</sup> to mean clinically healthy from a cardiovascular standpoint without manifest cardiovascular symptoms. They suggest that several people may have had cardiac pathology. If true, underlying heart disease or substances such as alcohol and some drugs would likely facilitate electrical induction of VF from the TASER shock. If the pathology were the cause of the VF, one would have to assume it triggered VF precisely at the time of the TASER shock, an improbable coincidence. They indicate that one case had long QT “on the day of his TASER activation.” This was present in the ECG recorded in the postresuscitation period after termination of VF with shocks of 200, 300, and 360 joules; infusion of drugs including epinephrine and lidocaine; a blood alcohol level of 0.35 g/100 mL; serum potassium of 3.3 mEq/L; and severe cerebral hypoxia. After cardiac recovery, the QT returned to normal. They indicate that another case subject had probe and drive stun shock applications, which is correct. In this individual, sufficient electricity delivered via 13 shocks in one or both modes of shock administration totaling 62 seconds reached his heart to cause cardiac arrest.

The authors state that swine hearts fibrillate more easily than humans but cite no supporting evidence. Swine studies have been used frequently to test the effects of the TASER X26.<sup>4</sup> In one such study, the authors concluded, “...pigs frequently have been used in fibrillation and defibrillation threshold studies with the results generalized to humans...Our data regarding myocardial capture, however, suggest the potential for induction of ventricular tachycardia in subjects with a substrate for ventricular tachycardia...”<sup>4</sup> These are precisely the points I made above.

Drs Vilke et al state that no TASER X26 human studies have demonstrated cardiac capture “without an exogenous pathway for conduction to the heart, such as pacemaker wires.” The latter is in reference to the case report by Cao et al,<sup>5</sup> in which a man with a pacemaker received two 5-second TASER X26 shocks that captured his heart at rates >200/min. Reanalysis of the ventricular electrograms in that case showed a contour change during TASER capture compared with normal pacing, supporting the conclusion that the TASER capture occurred independently and not over the implanted pacemaker lead (Cao M and Saxon L, personal communication).

Drs Vilke et al conclude that TASER use is not associated with a “substantial risk to the public.” TASER’s chief legal counsel estimates the risk of cardiac arrest “on the order of 1:100 000 applications”<sup>6</sup> and approximates a total of 2.86 million TASER ECD applications as of December 31, 2011.<sup>7</sup> That translates to 28 to 30 cardiac arrests, likely an underestimation, because the 1:100 000 estimate would probably be closer to 1:20 000 if only chest shots were considered,<sup>8</sup> increasing the number of cardiac arrests to ≈150.

Drs Ho and Dawes state that the probes did not make contact with one individual in my report. I respectfully disagree based on my

interpretation of the video showing his reaction to the shock, subsequent probe marks on the chest, witness observations, and eventual death. In my opinion, long QT was not a cause of death in another case (noted above). Their concern that my article “will potentially lead to restricted availability...” of these devices is not my intent, which is solely to draw attention to the fact that, in certain circumstances the TASER X26 can cause cardiac arrest and to suggest how to minimize that risk.

Regarding comments from Drs Heegaard, Halperin, and Luceri, I respectfully disagree that the probes missed contact in one case (noted above) and that pulse and respirations were maintained for 8 minutes after the TASER shock. Also, whether one case had fine VF or asystole (see above) does not impact my conclusion about TASER causing the cardiac arrest. Untreated VF evolves to fine VF and asystole over time.

In my opinion, TASER ECD safety has not been adequately demonstrated. In fact, the animal studies and clinical reports discussed in my article elevate and focus on the issue of safety, not reduce it.

However, my aim is not whether the use of TASER International’s products is appropriate; that is a decision for law enforcement experts. My goal is to educate users about the potential for cardiac arrest: (1) treat the ECD with the same respect as a firearm; (2) avoid chest shots and long and repeated trigger pulls if possible; (3) suspect cardiac arrest in any unresponsive individual, regardless of apparent movement or perception of a pulse or respiration; and (4) call for medical support and apply cardiopulmonary resuscitation and an automated external defibrillator as soon as possible.

Drs Heegaard et al suggest possible bias in my interpretation of facts in several of the cases. I respectfully disagree and suggest that Drs Heegaard et al could be biased because they own TASER shares (Dr Heegaard), serve on the TASER Scientific Medical Advisory Board, and function as an expert witness on behalf of TASER, International (Dr Luceri), as they have acknowledged.

In that regard, the 3 letters of criticisms were sent by physicians with TASER relationships and were directed toward aspects of a few single cases, not against the overall concept of TASER-induced VF. In my opinion, to a reasonable degree of medical certainty, the published body of evidence now makes it perfectly clear that a TASER X26 ECD shock can induce VF in humans, transforming the argument from if it can happen to how often it happens.

## Disclosures

Dr Zipes is an expert plaintiff witness against TASER, International, Inc.

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