Relation of Taser (Electrical Stun Gun) Deployment to Increase in In-Custody Sudden Deaths

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Despite controversy concerning their safety, use of electrical stun guns (Tasers) by law enforcement agencies is increasing. We examined the effect of Taser deployment on rates of (1) in-custody sudden deaths in the absence of lethal force, (2) lethal force (firearm) deaths, and (3) officer injuries (OIs) requiring emergency room visits. Under the Public Records Act and the Freedom of Information Act, 126 police and sheriff departments from California cities were mailed surveys requesting rates of each of the outcomes of interest for each of the 5 years preceding Taser deployment through the 5 years after deployment. To control for population size and crime rates, we used total annual arrests per city as reported to the Department of Justice. Fifty cities provided predeployment and postdeployment data on in-custody sudden death, 21 cities reported firearm deaths, and 4 cities reported OIs. The rate of in-custody sudden death increased 6.4-fold (95% confidence interval 3.2-12.8, p = 0.006) and the rate of firearm death increased 2.3-fold (95% confidence interval 1.3–4.0, p = 0.003) in the in the first full year after Taser deployment compared with the average rate in the 5 years before deployment. In years 2 to 5 after deployment, rates of the 2 events decreased to predeployment levels. We observed no significant change in the rate of serious OIs after Taser deployment. In conclusion, although considered by some a safer alternative to firearms, Taser deployment was associated with a substantial increase in in-custody sudden deaths in the early deployment period, with no decrease in firearm deaths or serious OIs. **(Am J Cardiol 2009;xx:xxx)**

Controversy exists as to whether electrical stun guns, also called neuromuscular incapacitating devices, can cause sudden death. The most popular brand of neuromuscular incapacitating devices is the Taser (Taser International, Scottsdale, Arizona). Tasers eject barbs that deliver a high-frequency, high-voltage, low-amplitude current to incapacitate victims by causing momentary skeletal muscle tetany and neuromuscular incapacitation. Although Tasers are marketed as a safer alternative to subdue prisoners and suspects in law enforcement custody,[1] recent reports have described a temporal association between use of stun guns and >300 in-custody sudden deaths in North America.[2,3] Despite the possible risks posed by these devices, Taser deployment by law enforcement agencies continues to grow; they are currently in use by >12,000 law enforcement, military, and correctional agencies in the United States and abroad.[4] We sought to determine the effect of Taser deployment by law enforcement agencies on rates of (1) in-custody sudden deaths in the absence of lethal force, (2) lethal force (officer firearm-related) deaths (LFDs), and (3) serious officer injuries (OIs) requiring emergency room visits.

Methods

Based on an initial inquiry distributed to police and sheriff departments in California, 126 were identified as having recently deployed Tasers. Surveys were then sent to these departments in a request for data under the Public Records Act and the Freedom of Information Act. In addition, surveys were sent to police departments of the 10 largest cities in the United States outside California. We surveyed for year of Taser deployment and incidence of in-custody sudden deaths in the absence of lethal force in the 5 years before through 5 years after Taser deployment (years −5 to +5). Year 0 was defined as the deployment year, during which cities implemented Tasers for 1 month to 12 months of year 0. We defined sudden death on our surveys as "unexpected in-custody deaths during nonlethal force situations." Total arrest data combining all felony and misdemeanor arrests for years −5 through +5 of Taser deployment for all cities surveyed were retrieved from the California Department of Justice Web site[5] and by contacting the Office of the Attorney General directly for more recent arrest statistics, as necessary. The year 2000 population for each city was obtained from the Census Bureau.[6]

Departments that returned the first survey were sent a

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Table 1
Population, arrest statistics, and year of Taser deployment of 84 California cities and counties in survey analysis

Characteristic	
Population by 2000 census	92,595 ± 164,626
Total misdemeanor and felony arrests in year of Taser deployment	2,921 ± 4,971
Year of Taser deployment	
1985–1990	4 (4.8%)
1990–1999	3 (3.6%)
2000–2004	46 (55%)
2005–2007	31 (37%)

Values are means ± SDs or numbers of subjects (percentages).

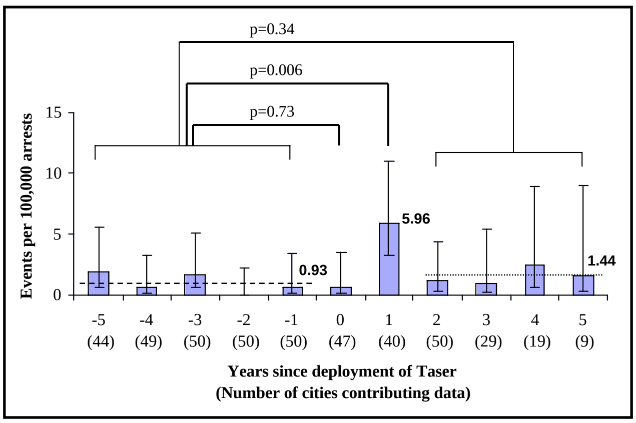

Figure 1. Mean rates of in-custody sudden deaths in the absence of lethal force by year before (years −5 to −1, 0.93/100,00 arrests) *(dashed line)* and after (years 2 to 5, 1.44/100,000 arrests) *(dotted line)* Taser deployment.

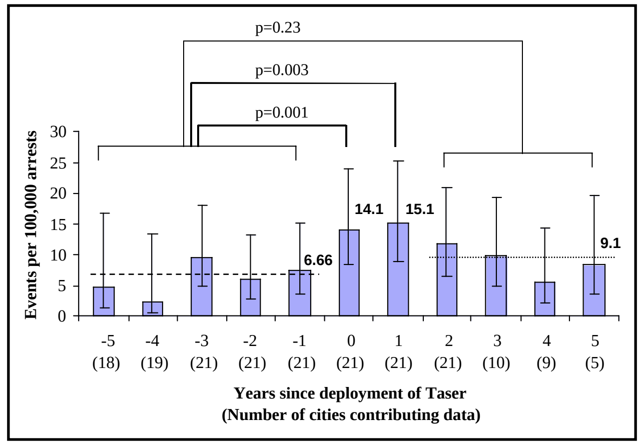

Figure 2. Mean rates of LFDs (by firearms) by year before (years −5 to −1, 6.66/100,00 arrests) *(dashed line)* and after (years 2 to 5, 9.1/100,000 arrests) *(dotted line)* Taser deployment.

follow-up survey for confirmation of sudden death rates and for additional data on incidence of LFDs and serious OIs requiring emergency room visits for the same 11-year period from 5 years before to 5 years after Taser deployment.

Data were compiled in an Excel spreadsheet (Microsoft, Redmond, Washington) and analyzed using STATA 10 (StatCorp LP, College Station, Texas). To assess secular trends in sudden death, LFD, and OI, we used Poisson regression models. Models were run using generalized estimating equations with exchangeable working correlation and robust SEs to accommodate within-city correlation and possible overdispersion. The total number of arrests for each study year was included in the model as an offset. The sample for each model was restricted to cities that reported outcomes in the pre- and postdeployment periods, so that each city serves to some extent as its own control. We used these models to estimate and compare average outcome rates in 4 periods: before deployment (years –5 to –1), the year of deployment (year 0), the first full year after Taser deployment (year +1), and years 2 to 5 after deployment.

Results

Of the 126 surveys sent to the police and sheriff departments of cities and counties identified as using Tasers, we received 113 responses (89.7%). We received no completed surveys from the 10 largest cities in the United States outside California; 1 city (Detroit, Michigan) was not using Tasers and the remaining 9 cities declined to release data. Thirty-two of the original 126 departments declined our request for data or returned incomplete surveys without data on sudden death. Thus, this analysis is based on the survey responses of 84 police and sheriff departments of moderate to large cities in California that returned survey data on sudden death. Population, numbers of total felony and misdemeanor arrests, and year of deployment for these 84 cities are presented in Table 1.

Only 50 of the 84 departments had available data on sudden death for ≥1 predeployment and 1 postdeployment year; 34 departments had deployed too recently to report this information. Rates per 100,000 arrests are summarized in Figure 1 for the 50 reporting departments. For each city, year 0 represented a partial-use year, depending on month of deployment. Over the entire reporting period, we found an average rate of 1.57 sudden deaths per 100,000 arrests in the 50 cities contributing to the analysis. Using the Poisson model, we estimate that the rate of sudden death decreased slightly from 0.93 per 100,000 arrests in the predeployment period (years −5 to −1) to 0.61 per 100,000 arrests in the deployment year (year 0, $p = 0.73$). In the first full year after deployment (year +1), the rate was 5.96 per 100,000 arrests, a 6.4-fold increase (95% confidence interval [CI] 3.2 to 12.8, $p = 0.006$) over the predeployment period (years −5 to −1). In years 2 to 5 after deployment, the sudden death rate decreased to 1.44 per 100,000, a significant decrease from the first full year after deployment (year +1, $p = 0.02$), but not significantly different from the predeployment period (years −5 to −1, $p = 0.34$).

Thirty-seven police and sheriff departments reported data on the incidence of LFDs, including 21 providing data for ≥1 predeployment and 1 postdeployment year. Figure 2 summarizes the LFD findings for these 21 cities. Using the Poisson model, we found that the rate of LFDs increased from 6.66 per 100,000 arrests in the predeployment period (years −5 to −1) to 14.1 per 100,000 arrests in the deployment year (year 0), a 2.1-fold increase (95% CI 1.3 to 3.4, $p = 0.001$). In the first complete year after deployment (year +1), the rate of LFDs remained high at 15.1 per 100,000 arrests, a 2.3-fold increase (95% CI 1.3 to 4.0, p =

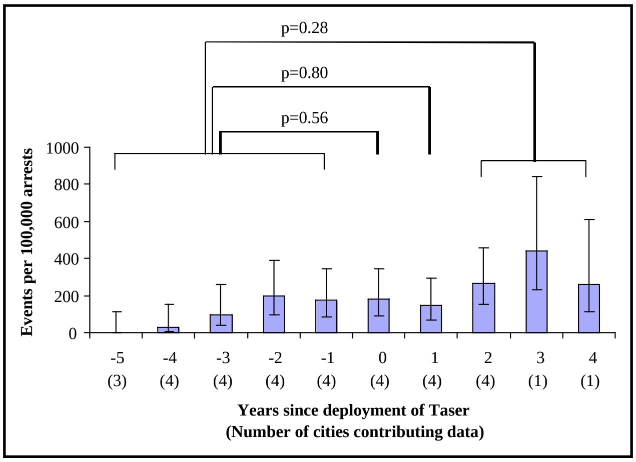

Figure 3. Rates of serious OI by year before and after Taser deployment.

0.003) over the predeployment period (years −5 to −1), but not significantly higher than the rate in the deployment year (year 0, $p = 0.79$). In years 2 to 5 after deployment, the rate of LFDs decreased to 9.1 per 100,000 arrests, a significant decrease from the first year after deployment (year +1, $p = 0.04$) but not significantly different from the predeployment period (years −5 to −1, $p = 0.23$).

Thirteen police departments returned follow-up surveys providing data on OIs, but only 4 of these cities provided data for ≥1 predeployment and 1 postdeployment year. Figure 3 summarizes the rates of OI per 100,000 arrests for the 4 departments contributing these data. The rate of OI in the predeployment period (years −5 to −1) was similar to the OI rates in the year of deployment (year 0), the first full year after deployment (year +1), and years +2 to +5 after deployment ($p = 0.56$, 0.80, and 0.28, respectively).

Discussion

In this epidemiologic study of police and sheriff departments of moderate to large cities in California using Tasers, we found a statistically significant 6.4-fold increase in the rate of in-custody sudden deaths not involving lethal (firearm) force in the first full year of Taser deployment compared with the predeployment period. Although Taser use has been advertised to decrease LFDs (by firearms) and prevent OIs, we observed no decrease in the rate of either event after Taser deployment. To the contrary, departments had a twofold increase in the rate of LFDs in the year of Taser deployment and the first full year after deployment, whereas the rate of serious OIs requiring visits to an emergency room was unchanged. Rates of sudden deaths and LFDs decreased to predeployment levels after the first full year of deployment.

Previous research on the cardiac and physiologic effects of Tasers have been inconclusive; these studies have mainly investigated whether Tasers can directly pace the heart into potentially lethal ventricular tachyarrhythmias by extremely rapid pacing or discharge during the vulnerable period in the cardiac cycle.[7–11] Anatomic and electrophysiologic differences between humans and pigs in the controlled, fully anesthetized condition in which these studies were performed limit their generalizability to humans.[12] In humans, 1 case report has demonstrated capture of ventricular myocardium at high rates,[13] and another has described a victim who was found in ventricular fibrillation after Taser application.[14] Other human studies have demonstrated cardiac safety but were performed with limited Taser applications in a dorsal position in healthy volunteers at rest.[15–18] These findings are difficult to extrapolate to real-world conditions in which Tasers are used. Police suspects would be expected to have unique physiologic (hyperadrenergic state), environmental (restraint techniques, multiple Taser applications near the heart on the torso), and external (illicit drugs) influences, any of which may make them more vulnerable to sudden death.

Some investigators have suggested that Tasers may also cause sudden death by increasing the risk of excited delirium.[19] Excited delirium is a much-debated condition, in which sudden death occurs after a violent struggle, often with police officers.[20,21] The exact mechanism of excited delirium is unknown, but it has been speculated that a surge in adrenergic tone, hyperthermia, or acidosis may decrease the threshold for life-threatening arrhythmias.[19,21] Thus, excited delirium may be another potential mechanism by which Tasers increase the rate of in-custody sudden death in the absence of lethal force. The intense pain associated with Taser applications would certainly lead to an increase in adrenergic tone that could be a trigger or contributory factor for excited delirium. Furthermore, studies in animal models and humans have demonstrated that Taser application can cause transient acidosis, another potential contributor to excited delirium.[22,23]

Notably, we found an increase in sudden deaths and LFDs in the early period of Taser deployment and then a decrease in these events to predeployment levels. We speculate that early liberal use of Tasers may have contributed to these findings, possibly escalating some confrontations to the point that firearms were necessary. The later decrease in sudden deaths and LFDs may reflect recognition of the adverse consequences of Taser application by law enforcement agencies, leading to an adjustment of usage and/or techniques to result in the observed decrease in the 2 events to predeployment levels.

Our study has several limitations. First, we did not ask law enforcement agencies for details about the reported in-custody deaths, and specifically we did not ask whether the Taser had actually been applied in those incidents. It is likely that the Taser was used only in a subset of these deaths. However, we controlled for non-Taser–related in-custody sudden deaths by using each department's historic data for comparison. The only common intervention for all cities studied during this period was deployment of the Taser. Second, our study is purely observational. Therefore, we cannot rule out potential confounding by secular crime or drug-use trends to explain the increase in in-custody sudden deaths in the first year after deployment. However, the fact that Tasers were introduced in different years in each city makes this explanation less plausible. In addition, our results are based on data from survey responses, which may have been inaccurate. The responses of the reporting departments may reflect variable interpretations of the questions, despite instructions that strictly defined in-custody sudden death, LFD, and serious OI. Fourth, a lack of complete survey responses from cities led to only a limited analysis of OIs; thus, this finding may be less reliable.

Likely, the greatest limitation of this study is that the analysis and results are based on a subset of cities reporting Taser use. Several California cities and all of the largest cities in the United States were unwilling to release information regarding Taser use and in-custody sudden deaths. In our anecdotal experience, several cities with highly publicized Taser-related sudden death events declined to provide data and we speculate that other cities with more Taser-related deaths may similarly have been less likely to return our survey. Thus, the observed association of Taser deployment with an early increase in in-custody sudden deaths in this study may actually be an underestimate because under-reporting would tend to attenuate any such association.

Based on this study, further epidemiologic research on the effect of Taser deployment on real-world outcomes is warranted. Transparency by law enforcement agencies with regard to Taser use and in-custody sudden death outcomes is critical for future studies by independent investigators.

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