Pneumothorax as a Complication After TASER Activation

Paul R. Hinchey, MD, MBA, Geeta Subramaniam, MD

Abstract

Use of the TASER electronic control device by law enforcement and civilians is increasing. Advocates for the use of the device believe that it has reduced the number of officer and suspect injuries. However, the use of the device is not without complications. Many of these injuries to superficial body structures or those sustained in the postactivation fall have been described in the literature. Injury to deep structures of the abdomen and chest were previously thought to be unlikely given the length of the TASER barb. This case report of a 16-year-old male patient who suffered a pneumothorax after TASER activation is thought to be the first reported in the literature. **Key words:** stun guns; TASER; electronic control devices; pneumothorax; safety; law enforcement

PREHOSPITAL EMERGENCY CARE 2009;13:532–535

Case Report

A 16-year-old male suspect was exposed to a single activation of a TASER X-26 (acronym for "Thomas A. Swifts Electric Rifle," TASER International, Scottsdale, AZ) electronic control device after kicking a police officer during attempts to restrain him. The suspect received two probes to the chest and lost postural integrity upon activation, resulting in an uncomplicated fall from a standing position. He was presented to the emergency department (ED) by police and emergency medical services (EMS) with a probe that remained lodged in the upper left pectoral muscle and could not be removed at the scene. A probe located in the right side of the chest was removed without difficulty prior to transport. The patient had a history of bipolar disorder but otherwise had no contributory past medical history, nor was there any drug or alcohol use reported.

When seen in the ED, the patient had localized grade 6 out of 10 pain at the site of the probe but did not have any additional complaint of chest pain or shortness of breath. He denied any other complaints related to the fall. He was mildly tachycardic at 102 beats/min, with an oxygen saturation of 98% on room air and otherwise normal vital signs without evidence of tachypnea. The physical examination revealed equal breath sounds and no appreciable subcutaneous air or chest wall injury other than soft-tissue tenderness at the site of the probe. After physical examination, no additional evidence of trauma from the fall was found.

The TASER probe was removed by freeing the barb with a scalpel after administration of local anesthetic. Although the patient had no complaints of shortness of breath and had an otherwise unremarkable physical examination, chest x-ray scans were obtained (Figs. 1 and 2). The patient was found to have a small to moderate-sized pneumothorax as described by the radiologist. No additional radiologic abnormalities or sources of the pneumothorax were found. The patient underwent tube thoracostomy and admission. He had resolution of his pneumothorax and was discharged after a two-day hospital stay.

Discussion

Although less-than-lethal electrical weapons have been in use since the 1970s, the TASER X26 electronic control device, introduced in 1999, employs neuromuscular incapacitation rather than pain compliance to achieve control of a combatant.[1] The TASER utilizes two 13-millimeter barbed probes connected by wires to the device. These probes are propelled by a nitrogen gas charge at 160 feet/second up to a maximum range of 35 feet (10.66 meters). Once deployed, the TASER will deliver current for up to 5 seconds per trigger pull. The user can terminate the delivery of current at any time by releasing the trigger. The device delivers 19 pulses per second with an average current per pulse of 2.1 milliamps.[2] According to TASER International, the device has been used on volunteers in training 681,000 times and in 547,000 field applications.[3] There is no mention of injury rates specific to these applications.

The TASER device has become popular with police agencies around the world because it allows police to temporarily disable combatants from a safe distance. The use of neuromuscular incapacitation rather than pain compliance limits the suspect's ability to resist and provides a window of opportunity for police to apply traditional restraints such as handcuffs. Applying restraints when the suspect is incapacitated is thought to reduce the risk of physical injury to both the officer and the suspect by limiting the need for more dangerous close-contact pain compliance or control techniques. Based on statistics published by TASER International, the device has resulted in a 45–93% reduction in officer injuries and a 35–82% reduction in

Received February 2, 2009, from WakeMed Health and Hospitals (PRH, GS), WakeMed Emergency Services Institute (PRH); and Wake County EMS (PRH), Raleigh, North Carolina. Revision received April 10, 2009; accepted for publication April 21, 2009.

Address correspondence and reprint requests to: Paul R. Hinchey, MD, MBA, Emergency Services Institute, WakeMed Health and Hospitals, 3000 New Bern Avenue, Raleigh, NC 27614. e-mail: phinchey@wakemed.org

doi: 10.1080/10903120903144890

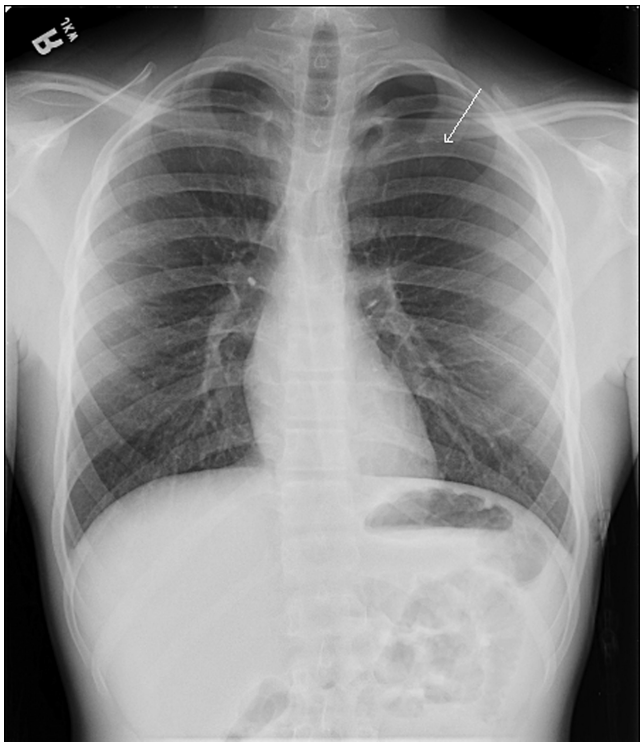

FIGURE 1. Chest radiograph (posteroanterior view) with pneumothorax (*arrow*) after removal of the TASER barb.

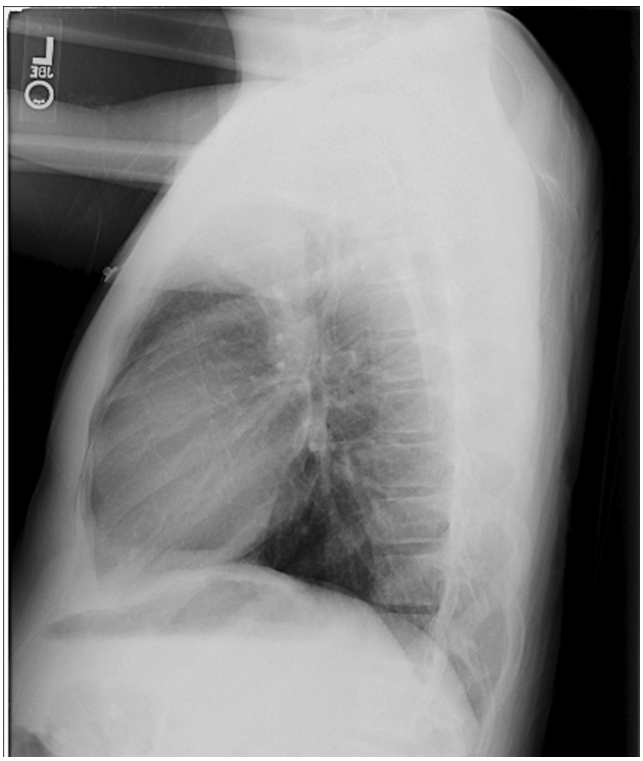

FIGURE 2. Chest radiograph (lateral view) indicating chest wall thickness after removal of the TASER barb.

suspect injuries in police jurisdictions where the device is used. The company website (http://www.taser.com) also credits the TASER with decreased use of impact weapons such as batons (25–34%) and other striking techniques (32–38%) and decreased use of pepper spray (38–100%).[4] A non–law-enforcement version of the device is available for purchase by the lay public willing to register their device and complete a screening process.

Since the release of the TASER, there has been a great deal of scrutiny associated with its use. The majority of the published research focuses on the use of the TASER while attempting to restrain suspects believed to be suffering from agitated delirium. Opponents of the device feel there is a causal relationship between the use of the device and in-custody deaths, whereas proponents argue that in-custody deaths and deaths due to agitated delirium occurred prior to the development of the TASER. The first known description of agitated delirium or Bell's mania was originally described by Bell in 1849 when he observed that some institutionalized psychiatric patients with sustained agitation developed fever and died suddenly.[5] Numerous cases and case series have been published describing death from agitated or excited delirium as the result of drugs or psychiatric conditions with and without the use of the TASER. Researchers have attempted to describe the cause of death in these cases and identify what, if any, role the TASER may play. Several hypotheses exist as to why these patients suffer sudden death including complications of hyperthermia, rhabdomyolysis, acute metabolic acidosis, and direct cardiac toxicity of stimulants as well as the effects of the TASER on the heart.[6] Studies of the TASER use in healthy subjects have been unable to generate identifiable conditions that might lead to sudden death.[7–9] Critics of these studies attribute the lack of findings to a healthy subject bias. However, other studies have attempted to reproduce conditions of hyperadrenergic states, metabolic or respiratory acidosis, and even varying dart deployment about the cardiac axis in pigs without conclusive results.[10–12] These studies, though valuable, have significant limitations and highlight the difficulty in reproducing what is likely to be a multifactorial cause of sudden death.

While the role of the TASER in these in-custody deaths remains fiercely debated, less attention is paid to injuries related to the direct trauma from the projectiles or subsequent falls. Described injuries have ranged in severity from simple contusions, abrasions, and lacerations from falls to mild rhabdomyolysis, vertebral fracture, testicular torsion, miscarriage, and cataract formation from the effects of the current.[13–17] Previously described probe injuries include perforating globe injury, intracranial penetration, pharyngeal perforation, and even intentional ingestion of a TASER probe.[16,18,19] However, direct injuries to the lungs, heart, and bowel caused by the TASER probes were thought to be unlikely because

of the depth of these structures and the length of the barb.[20]

In this case, the patient suffered a pneumothorax, an as-yet-undescribed injury after a TASER deployment. Although penetrating injury to the lung is suspected, the probe was removed prior to obtaining the x-ray scans and cannot be confirmed based on radiologic findings. Alternative reasons for the finding include a preexisting pneumothorax or an injury sustained subsequent to the fall. Injury during removal was considered; however, the probe was removed by instilling local anesthetic and freeing the probes barb with a scalpel using minimal dissection and was not likely to result in violation of the pleura.

While it is possible that the patient had a preexisting pneumothorax, this is considered unlikely as he had no reported symptoms and no history of the use of inhalants, asthma, previous spontaneous pneumothorax, or other medical condition that would put him at risk for such a condition. The possibility that the pneumothorax was not caused by the dart itself but by the subsequent fall is also a consideration. A common source for this injury would be a rib fracture resulting in underlying lung injury. However, there was no radiographic evidence or significant pain on examination to suggest such an injury. Direct compression of the chest wall and lung against a closed glottis, the so-called "brown bag effect," is a recognized source of pneumothorax, particularly in motor vehicle trauma. This mechanism is thought to be unlikely in a simple fall from standing height, but cannot be excluded.

Several factors suggest that the injury sustained may have been caused by the dart penetrating the full thickness of the thoracic wall. The police were in the process of attempting physical restraint without the use of the TASER when the officer was kicked. As a result, the officer was thought to be in close proximity to the combatant when the TASER was deployed. The exact distance from the suspect cannot be determined from available information, but close proximity could have resulted in higher velocity of the projectiles at the time of contact than is typically seen. The patient's body habitus may also have contributed to the dart's ability to penetrate the chest wall. The patient was estimated to be 5 feet 11 inches tall (180 cm) and 145 lb (66 kg), with a body mass index (BMI) of 20.4 kg/m^2. This is considered a "normal" body habitus (normal 18.5–24.9 kg/m^2), but could arguably be described as "thin" in the current U.S. population where, according to the Centers for Disease Control and Prevention (CDC), the average BMI in the 16-year-old age group has increased from 21.9 kg/m^2 in 1966 to 24.0 kg/m^2 today. A review of the lateral chest x-ray scan, though limited in its ability to assess chest wall thickness at the time of TASER deployment, revealed little subcutaneous fat and a chest wall thickness ranging from 1.9 to 2.5 cm in the area of the probe. The 13-millimeter probe length is not likely to have reached the underlying lung from the deployment alone. However, the subsequent fall on the impaled dart or compression of the chest in a prone position while restraining the patient could have resulted in sufficient force to compress the soft tissue and drive the probe deeper into the chest wall.

No physical confrontation with the police is without risk of injury to both the officer and the combatant. Traditional police tactics employ deadly force with firearms or pain compliance by using holds or striking techniques. By the very nature of these techniques there is an increased potential for injury or death. Unfortunately, these tactics are not effective in some combatants who, because of psychiatric or toxicologic conditions, have reduced sensitivity to pain. These cases result in prolonged struggle with officers and require repeated use of injurious pain techniques to gain compliance. While not without risks, the TASER has significant advantages over pain compliance techniques through its incapacitating effects on the suspect, which allows rapid application of restraints and reduces the need for strikes and holds.

Injuries sustained by suspects exposed to the TASER are likely to prompt calls for EMS evaluation. However, literature on the interaction between EMS personnel and these patients is scarce. EMS providers and their medical directors should be encouraged to work with their local law-enforcement agencies to develop a systematic approach to these patients. Examples of formalized protocols exist[21,22]; however, the number of EMS or law-enforcement agencies that have implemented such protocols is unknown. Police procedures should identify whether or when TASER barbs should be removed by law enforcement and when patients should be evaluated by EMS or in the ED for injuries from TASER probes or the subsequent fall. Removal of TASER probes by EMS personnel is at the discretion of the medical director; however, any TASER probe involving structures of the head, neck, or genitals, or those not easily removed with simple traction, should be evaluated in the ED.

Given the difficulty of predicting who will develop agitated delirium progressing to death, law-enforcement officers should be trained to recognize the signs and symptoms of the condition. Police procedures should include early activation of the EMS system in suspects with symptoms suggestive of agitated delirium. If the scene can be safely contained without risk to officers or the public, the presence of EMS at the time of restraint may facilitate early sedation to prevent ongoing struggle against restraints and early evaluation and treatment in cases of suspected agitated delirium.

The widespread adoption of the TASER in law enforcement and the availability to the lay public are

likely to increase the number of cases presented to EMS or the ED for evaluation. The development of a standardized approach to these patients is recommended. Understanding of the potential injuries that may result is essential to formulating a differential diagnosis and effective assessment and treatment of these cases. Further research is required to identify what factors may increase the risk of injury to deep vital structures and prompt a more thorough evaluation. This case serves as a reminder that vigilance and awareness of potential injuries related to TASER use are essential when directing evaluation of these patients.

References

1. History of TASER devices. Available at: http://www.taser.com / research / Science / Pages / HistoryofTASERDevices.aspx. Accessed January 3, 2009.
2. TASER X26E operating manual. Available at: http://www.taser.com/SiteCollectionDocuments/Downloads/MK-INST-X26E-001%20REV%20B%20X26E%20Manual.pdf. Accessed January 3, 2009.
3. Current electronic control device research. Available at: http://www.taser.com/RESEARCH/SCIENCE/Pages/CurrentElectronicControlDeviceResearch.aspx. Accessed January 3, 2009.
4. TASER electronic control devices: field data and risk management. Available at:http://www.taser.com/company/pressroom/Documents/Injury%20Reduction%20Stats%20PUBLIC%2003%2005%2009.pdf.
5. Kraines S. Bell's mania. Am J Psychiatry. 1934;91:29–40.
6. Park KS, Korn CS, Henderson SO. Agitated delirium and sudden death: two case reports. Prehosp Emerg Care. 2001;5:214–6.
7. Ho JD, Miner JR, Lakireddy DR, Bultman LL, Heegaard WG. Cardiovascular and physiologic effects of conducted electrical weapon discharge in resting adults. Acad Emerg Med. 2006;13:589–95.
8. Levine SD, Sloane CM, Chan TC, Dunford JV, Vilke GM. Cardiac monitoring of human subjects exposed to the Taser. J Emerg Med. 2007;33:113–7.
9. Vilke GM, Sloane CM, Bouton KD, et al. Physiological effects of a conducted electrical weapon on human subjects. Ann Emerg Med. 2007;50:569–75.
10. Chan TC, Vilke GM, Neuman T, Clausen JL. Restraint position and positional asphyxia. Ann Emerg Med. 1997;30:578–86.
11. Nanthakumar K, Billingsley IM, Masse S, et al. Cardiac electrophysiological consequences of neuromuscular incapacitating device discharges. J Am Coll Cardiol. 2006;48:798–804.
12. Lakkireddy D, Wallick D, Verma A, et al. Cardiac effects of electrical stun guns: does position of barbs contact make a difference? Pacing Clin Electrophysiol. 2008;31:398–408.
13. Winslow JE, Bozeman WP, Fortner MC, Alson RL. Thoracic compression fractures as a result of shock from a conducted energy weapon: a case report. Ann Emerg Med. 2007;50:584–6.
14. Mehl LE. Electrical injury from Tasering and miscarriage. Acta Obstet Gynecol Scand. 1992;71:118–23.
15. Ordog GJ, Wasserberger J, Schlater T, Balasubramanium S. Electronic gun (Taser) injuries. Ann Emerg Med. 1987;16:73–8.
16. Chen SL, Richard CK, Murthy RC, Lauer AK. Perforating ocular injury by Taser. Clin Exp Ophthalmol. 2006;34:378–80.
17. Seth RK, Abedi G, Daccache AJ, Tsai JC. Cataract secondary to electrical shock from a Taser gun. J Cataract Refract Surg. 2007;33:1664–5.
18. Rehman TU, Yonas H, Marinaro J. Intracranial penetration of a TASER dart. Am J Emerg Med. 2007;25:733e3-4.
19. Koscove EM. Taser dart ingestion. J Emerg Med. 1987;5:493–8.
20. Lutes M. Focus On: Management of TASER injuries. ACEP News. May 2006. Available at http://www3.acep.org/publications.aspx?id=24740. Accessed January 27, 2009.
21. Wake County EMS System. Adult protocols. Available at: http://www.wakegov.com/NR/rdonlyres/2F6EC7F4-DCBF-4AED-A071-12E1D2AAAA8B/0/2007Adult.pdf. Accessed March 28, 2009.
22. Taser barb removal. Available at: http://biotel.ws/treatmentguidelines/TASERBarbRemoval.html.