REUE | Review Article

Systematic review with narrative synthesis on energy-conducting devices (Tasers) and their implication in out-of-hospital emergencies

Diego Borraz-Clares, Leticia Serrano-Lasaosa, Marta Gasca-Carceller, Armando Cester-Martínez

INTRODUCTION. Conducted Energy Devices (CEDs) are a tool used by law enforcement as an alternative to firearms. Their objective is to increase safety in interventions for the police, the aggressor, and the general public. The main objective of this article is to identify and analyze the existing evidence on the functioning of CEDs, the physiopathological effects after discharge, and the therapeutic measures applied to ensure quality health care.

MATERIAL AND METHODS. We conducted systematic review with narrative synthesis of the results across PubMed, Cochrane Library, and ScienceDirect databases. The search was performed from August through November 2024 using the terms "Taser," "Conducted Energy Weapon Injuries"[MeSH], "Emergency Medical Services"[MeSH], among others.

RESULTS. A total of 121 articles were identified, with 18 studies selected for inclusion in the article. Following the analysis, the functioning of CEDs, the most common injuries caused by electrode impact, and complications likely caused by the passage of electric current through the body were described, in addition to the health care that should be provided to these individuals.

CONCLUSION. CEDs present low morbidity and mortality, but also risks that require protocolized health care intervention, life support training, and further research on their effects and complications.

Keywords: Taser. Out-of-Hospital Emergency Medical Services. Conducted Energy Devices. Electrical Injuries.

Revisión sistemática con síntesis narrativa sobre dispositivos conductores de energía (Taser) y su implicación en emergencias extrahospitalarias

INTRODUCCIÓN. Los dispositivos conductores de energía (DCE), son una herramienta utilizada por las fuerzas del orden como alternativa a las armas de fuego. Su objetivo es aumentar la seguridad en las intervenciones, tanto para la policía, como para el agresor, y para el resto de la ciudadanía. Este artículo trata de identificar y analizar la evidencia existente sobre el funcionamiento de los DCE, los efectos fisiopatológicos tras la descarga y las medidas terapéuticas aplicadas para garantizar una atención sanitaria de calidad.

MATERIAL Y MÉTODOS. Se realizó una revisión sistemática con síntesis narrativa de los resultados utilizando las bases de datos PubMed, Cochrane Library y Science Direct. La búsqueda se realizó entre agosto y noviembre de 2024 utilizando los términos "Taser", "Conducted Energy Weapon Injuries"[MeSH] y "Emergency Medical Services"[MeSH].

RESULTADOS. Se identificaron 121 artículos, siendo seleccionados 18 estudios. Tras el análisis, se describió el funcionamiento de los DCE, las lesiones más habituales causadas por el impacto de los electrodos, así como las complicaciones probablemente causadas por el paso de la corriente eléctrica por el organismo, además de la asistencia sanitaria que debe prestarse a estos sujetos.

CONCLUSIÓN. Los DCE presentan una baja morbimortalidad, pero con riesgos que requieren intervención sanitaria protocolizada, formación en soporte vital y más investigación sobre sus efectos y complicaciones.

Palabras clave: Taser. Servicios de Emergencias Extrahospitalarias. Dispositivos conductores de energía. Lesiones por electricidad.

Introduction

Conducted energy devices (CEDs) are non-lethal weapons designed to temporarily incapacitate an individual by delivering an electric shock administered remotely. This discharge is transmitted through wires connected to electrodes that are projected onto the target's body. It is important to distinguish them from Contact Discharge Devices (CDDs), which require direct contact with the body to deliver the shock and are prohibited in Spain, thus not addressed in this article. Their prohibition is due to their ability to generate currents of several tens of milliamperes (mA) and the potential to cause irreversible injuries.[1]

Among CEDs, the Taser, particularly the Taser 7, stands out as the most widely used model globally. There-

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Figure 1. Taser Model 7 handgun.
Author's own image.

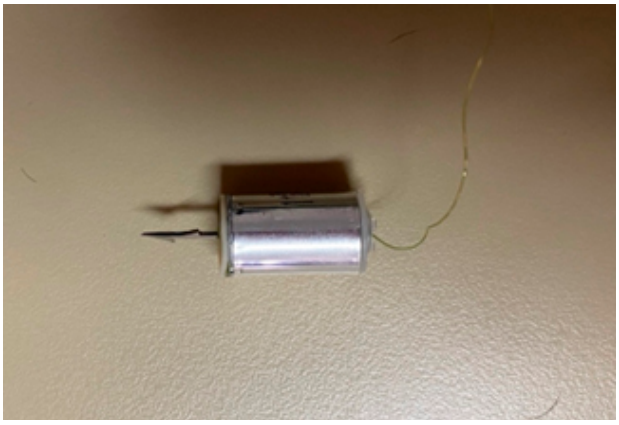

Figure 2. Electrodes corresponding to a Taser 7.
Author's own image.

fore, although this work focuses on CEDs, all further references will pertain specifically to the Taser.

The implementation of Tasers by police forces responds to the need for an intermediate tool in the use-of-force continuum, especially in complex situations, such as interventions involving aggressive or agitated individuals.[2] Their use reduces the likelihood of injuries to the subject and increases safety in the surrounding environment.[3-5]

A 2009 study including 1,201 individuals subdued with a Taser reported that 99.75% did not sustain significant injuries.[6] Similarly, a retrospective study published in 2020, which analyzed 5,444 Taser uses, found that 485 (9%) resulted in injuries, representing the lowest injury rate when compared with those caused by police dogs, irritant sprays, batons, or direct physical confrontation.[7,8]

Currently, Tasers are implemented in more than 100 countries, including Spain. Therefore, it is relevant that Spanish Out-of-Hospital Emergency Services (OHEMS)—both those involved in tactical medicine and those that are not—understand the operational principles and potential injuries caused by these weapons.[9]

Basic operating principles of the Taser

The Taser consists of a plastic body shaped like a handgun (Figure 1) that houses a lithium battery. At the front end, two cartridges are loaded, each containing a compressed nitrogen reservoir, which, when activated, propels two probes at a velocity of 48.77 meters per second. These probes contain harpoon-shaped electrodes (Figure 2) and conductive wires through which the electrical pulses travel to the electrodes, transmitting to the body.[10]

The safest target areas of the body, minimizing the risk of severe injury, are the upper back for rear discharges and the abdomen and lower extremities for frontal discharges.[10,11]

Once the electrodes reach the target, they penetrate approximately 0.66 cm, delivering a discharge of 1,200 volts with an average intensity of 2.1 mA per shot.

The discharge lasts 5 seconds after pulling the trigger, even if the trigger remains pressed. However, it can be repeated multiple times by activating a separate button. If the main trigger is pressed again, the second cartridge is fired.[10,11]

The main objective of this article is to identify and analyze existing evidence on Taser function, pathophysiological effects following discharge, and therapeutic measures necessary to ensure high-quality medical care.

Materials and methods

We conducted a systematic review with a narrative synthesis of results. No quantitative analysis was conducted due to data heterogeneity. The primary search was conducted in PubMed, and extended to Cochrane Library and ScienceDirect.

The PRISMA methodology[12] was followed throughout the search and synthesis phases. The review was conducted between August and November 2024.

The search strategy included the following MeSH terms and keywords: "Conducted Energy Weapon," "Electric Injuries" [MeSH], "Taser," "Conducted Energy Weapon Injuries" [MeSH], "electrical weapon," "Emergency Medical Services" [MeSH], "health effects," and "physiological effects." Boolean operators AND and OR were used. The search was limited to human studies.

The time frame was restricted to 2014–2024 to include the most up-to-date literature. Only English and Spanish publications were included. Eligible study designs were original investigations, systematic reviews, meta-analyses, observational studies, and narrative reviews.

Excluded publications included opinion pieces, animal studies, and technical analyses focused solely on Taser design without clinical implications. An example PubMed search equation used was: "(((conducted energy weapon) OR (taser)) AND (health effects)) OR (conducted energy weapon injuries [MeSH Terms]) Filters: Clinical Trial, Comparative Study, Meta-Analysis, Observational Study, Randomized Controlled Trial, Review, Systematic Review, English, Spanish, Humans, from 2014–2024."

Finally, risk of bias was assessed using the CASPe tool. Data extraction was performed independently by two reviewers, with discrepancies resolved by a third reviewer.

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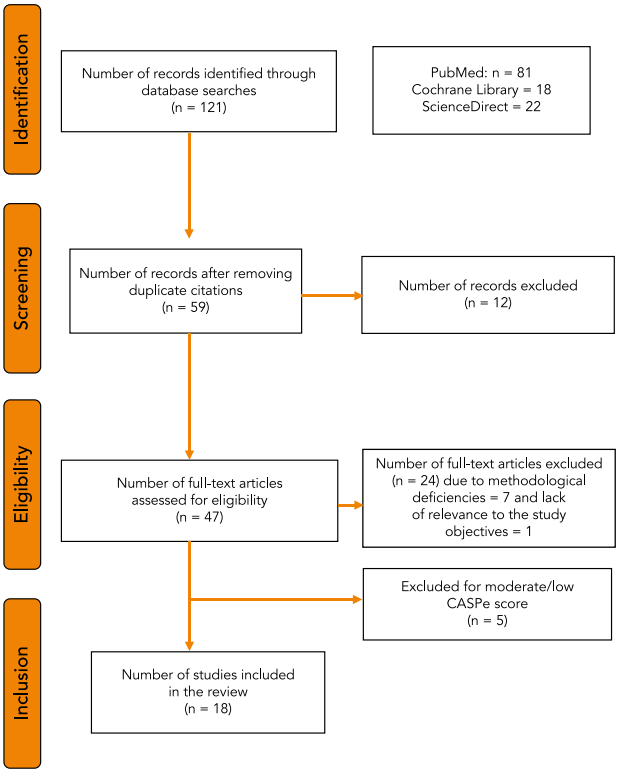

Figure 3. Search strategy.

Results

We identified a total of 121 articles. Of these, 62 duplicates were removed, leaving 59 studies for initial screening. Title and abstract review led to the exclusion of 12 studies not meeting inclusion criteria.

The remaining 47 studies underwent full-text evaluation. During this stage, 24 articles were excluded for methodological deficiencies or lack of relevance to study objectives. Subsequently, CASPe scoring for validity and bias led to the exclusion of an additional 5 studies with moderate or low scores. Although results varied across studies, common methodological limitations were identified, including retrospective design and selection bias, which should be considered when interpreting overall findings.

Finally, a total of 18 articles were included in the systematic review for providing relevant information on Taser operation, associated risks and injuries, and applicable therapeutic measures following exposure (Table 1).

From the systematic analysis, several relevant findings were identified: the electrical discharge produced by the Taser mimics nervous system impulses, acting on the sensory and motor functions of the peripheral nervous system. This results in involuntary muscle contractions and, consequently, neuromuscular incapacitation, immobilizing the individual. This mechanism is the main effect of the Taser, contrasting with contact discharge devices, which act primarily by causing intense local pain. Therefore, Tasers are effective even in subjects with a high pain tolerance.[1-5] No significant neurocognitive effects have been observed, apart from transient disorientation.[13]

A 5-second discharge does not alter heart rate, body temperature, or diastolic blood pressure. However, a statistically significant increase in systolic blood pressure has been documented, returning to baseline within 5 minutes.[14]

At the respiratory level, an increase in tidal volume and respiratory rate is observed within the first minute post-discharge, normalizing within 10 minutes. No evidence of hypoxemia or hypoventilation has been found, although some studies mention a transient decrease in oxygen saturation during discharge, with immediate recovery.[15]

In blood parameters, capillary blood analysis shows a decrease in pH and bicarbonate, and a slight increase in lactate, normalizing within 30–60 minutes. Prolonged exposures are associated with moderate lactic acidosis.[16] Venous blood analyses revealed no significant differences in calcium, sodium, potassium, creatine kinase, myoglobin, or troponin I.[1,17-21]

No alterations were found in complete blood count (red cells, platelets, neutrophils, lymphocytes, hematocrit, or hemoglobin), and Tasers have not been linked to coagulation disorders or thrombosis.[22-24]

Studies conducted on healthy volunteers have shown no significant ECG changes.[19]

The most common physiological effects produced by Taser discharges are summarized in Table 2.

Complications derived from Taser deployment can be classified into primary and secondary complications.

PRIMARY COMPLICATIONS

They are directly related to the electric current, and their severity depends on the way the current is applied, its duration, and the number of discharges.

Arrhythmias and cardiac arrest (CA)

The available scientific evidence does not establish a significant correlation between the application of a Taser discharge and the reported cases of CA.[4,18,25] The energy delivered by this device has a practically negligible probability of inducing fibrillation or ventricular tachycardia.[19,26-28] However, the risk increases when the discharge is administered to the thorax, especially if the electrodes impact near the heart.[1,25] A case has been described involving an adolescent who developed ventricular fibrillation following a discharge.[29] Arrhythmic events have also been reported in the presence of underlying causes[30,31]—either isolated or combined—such as chest impacts, stimulant drug use, or multiple or prolonged discharges.[1]

This group may also include individuals experiencing excited delirium syndrome (EDS)—a condition characterized by altered consciousness, psychotic symptoms, hyperthermia, extreme agitation or aggression, and reduced pain sensitivity.[1,2,32-34] This syndrome often involves violent confrontation with law enforcement, prone restraint, and consumption of cocaine, alcohol, other stimulants, or psychotropic drugs in 90% of cases.[23,35] Most autopsies of deceased EDS patients fail to identify a clear cause of death, although some suggest it may result from

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Table 1. Main conclusions of the selected studies

Authors	Title	Study Type	Findings & Conclusions	CASPe
Hallett *et al.*, 2019[2]	Taser use on individuals experiencing mental distress: An integrative literature review.	Systematic review & meta-analysis	In people with mental disorders, Taser use is increasing with a higher number of discharges. Little research exists on physical/psychological consequences and its effectiveness as an alternative to force.	8/10
LeClair *et al.*, 2015[4]	Taser and Conducted Energy Weapons.	Narrative review (peer-reviewed)	Probability of severe injury is extremely low. Although CEDs may contribute to sudden unexpected death, no clear causal link has been demonstrated.	8/10
Jauchem, 2014[5]	TASER conducted electrical weapons: misconceptions in the scientific/medical and other literature	Systematic review	The effects of CEDs and their association with high mortality are often overstated, as is labeling them as excessive force or torture.	8/10
Manhas *et al.*, 2021[7]	Non-lethal weapon: Injury patterns and imaging correlates for firearm alternatives	Systematic review	Impact to abdominal and limb areas is recommended to avoid major injuries. CEDs are deemed effective and safe for immobilizing subjects.	9/10
Stevenson *et al.*, 2020[8]	Medical implications of Conducted Energy Devices in law enforcement	Systematic review	Taser use results in fewer injuries compared with other police tactics. Emphasizes the importance of medical personnel evaluating individuals after a discharge.	7/10
Dawes *et al.*, 2018[13]	The neurocognitive effects of a conducted electrical weapon compared to high intensity interval training and alcohol intoxication - implications for Miranda and consent	Prospective case–control study	No disorientation or incoherence at 5–10 minutes post-discharge; no long-term neurocognitive deficit.	9/11
Baliatsas *et al.*, 2021[16]	Human Health Risks of Conducted Electrical Weapon Exposure. A Systematic Review	Systematic review	Health risk after Taser use can be estimated as low. Involving healthcare personnel to assess real-world impact may be very useful, especially in high-risk groups.	9/10
Vilke *et al.*, 2019[18]	Emergency department evaluation after conducted energy weapon use: review of the literature for the clinician	Systematic review	Exposure to CEDs up to 15 seconds rarely causes severe injuries, but clinicians should assess for trauma, burns, and other symptoms per the clinical picture.	8/10
Kroll *et al.*, 2020[20]	Electrical weapons and rhabdomyolysis	Prospective cohort study	CEDs caused no significant changes in proteins or enzymes. CA and alkaline phosphatase decreased at 24 h; no rhabdomyolysis risk found.	9/10
Ho *et al.*, 2020[21]	The physiologic effects of a new generation conducted electrical weapon on human volunteers at rest	Prospective observational study	Physiologic effects of the Taser 7 appear similar to prior generation and not harmful to health.	8/10
Ho *et al.*, 2014[22]	Physiologic effects of a new-generation conducted electrical weapon on human volunteers	Prospective cohort study	No evidence of danger to physical integrity with the X2 device; effects similar to earlier models.	9/11
Jauchem, 2015[23]	Exposures to Conducted Electrical Weapons (Including TASER® Devices): How Many and for How Long are Acceptable?*	Narrative review	Proper Taser use is more effective and less dangerous than other force options. More study is needed on safety with multiple and prolonged exposures.	8/10
Kroll *et al.*, 2020[24]	Electrical weapons, hematocytes, and ischemic cardiovascular accidents	Cohort study	No significant effects on platelets, red blood cells, or hematocrit; thrombotic/cardiac event risk is minimal after CED use.	9/11
O'Brien *et al.*, 2014[32]	Police use of Tasers in mental health emergencies: A review	Review	Taser use in mental health emergencies is under-studied, with unresolved questions and lacking perspectives of people with mental illness—highlighting the need for more research.	8/10
Kunz *et al.*, 2018[39]	A comparative brief on conducted electrical weapon safety	Systematic review	Cardiovascular risk after a discharge is controversial. Medical review including neurological assessment is advised; in deaths, investigate possible association with the discharge.	8/10
Kroll *et al.*, 2017[49]	Fatal and non-fatal burn injuries with electrical weapons and explosive fumes	Retrospective descriptive observational study	Some severe burn cases linked to CEDs are reported, though rare and preventable. When burns occur, they are usually minor.	8/10
Kroll *et al.*, 2016[54]	Fatal traumatic brain injury with electrical weapon falls	Retrospective cohort study	Low physiological risk from Taser use, but high risk of death from traumatic brain injury; age increases risk.	9/11
Bleetman *et al.*, 2022[57]	The use of TASER devices in UK policing: an update for clinicians following the recent introduction of the TASER 7	Review	CEDs can cause burns or fall injuries, among others. Require evaluation by qualified healthcare staff: assess tissue injury, provide cardiac monitoring, and perform obstetric review if the patient is pregnant.	7/10

CEDs: Conducted Energy Devices; CA: cardiac arrest.

a Takotsubo-like cardiomyopathy due to catecholaminergic myocardial stress.[36] While isolated discharges do not pose a significant risk of death,[37] repeated discharges may act as a triggering or aggravating factor, potentially increasing mortality.[38]

Cardiac device dysfunction

The presence of pacemakers or implantable cardioverter-defibrillators (ICDs) does not constitute an absolute contraindication for Taser use.[39] However, the literature remains limited.

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Table 2. Effects produced by a Taser in an individual

Neuromuscular incapacitation causing immediate fall to the ground
Involuntary muscle contractions
Paralysis of the lower limbs
Dazed sensation
Feeling of vertigo
Amnesia regarding the effects of the Taser and the pain
Tingling sensation
Inability to respond to verbal commands

Adapted from Peel M *et al.*[11]

Haegeli *et al.*[40] documented a case in which an ICD carrier experienced ventricular fibrillation during a Taser discharge, although the device did not activate due to insufficient time for reconfirmation. They also observed a persistent reduction in defibrillator activation threshold from 2.4 V/0.5 ms to 0.5 V / 0.5 ms, of unknown cause.

Similarly, Paninski *et al.*[41] reported another case where the ICD threshold decreased following a discharge, resulting in ventricular tachycardia. Cao *et al.*[30] observed a similar case, but without a change in the ICD activation threshold.

Regarding pacemakers, no human cases describing Taser-related interference have been reported.[42]

Acute coronary syndrome

Kroll *et al.*[24] described 2 cases: a 37-year-old man with ST-segment elevation in leads II, III, and aVF after a thoracic discharge, with normal subsequent angiography. Case #2 is that of a 20-year-old man with acute inferior myocardial infarction, associated with anabolic steroid use and a 5-second discharge.

Seizures

A case of generalized tonic–clonic seizure was reported after an electrode impacted the occipital region of a 30-year-old man without prior seizure history.[43]

Stroke

A 32-year-old man developed an ischemic stroke after a Taser discharge, with an electrode embedded in the frontal region.[24,44]

Miscarriage

A miscarriage was documented one week after a discharge to the abdomen and leg of a pregnant woman at 8–12 weeks' gestation.[45]

Rhabdomyolysis

Electrical discharge can cause muscle damage leading to acute renal failure, particularly after multiple discharges.[46,47] Two cases are described in the literature: a 51-year-old man, following an aggressive episode and self-inflicted injuries, developed rhabdomyolysis 12 hours after reconstructive surgery; and the case of a 31-year-old man with schizophrenia, who required three 5-second discharges for restraint.[48]

Table 3. Criteria for hospital referral

Underlying medical cause: excited delirium syndrome, medical condition, psychiatric disorder, or substance use.
Patients with risk factors: minors, chronic patients, pregnant women, pacemaker or defibrillator carriers, those on anticoagulant therapy (risk of hemorrhage) or statins (risk of rhabdomyolysis).
Injuries caused by the CED: trauma or secondary injuries from barbs requiring hospital evaluation (e.g., ocular injury).
Individuals with electrodes in the skull, eyes, ears, nose, mouth, neck, face, genitals, breasts, groin, spine, hands, feet, or joints must also be transported.
ECG abnormalities or thoracic impacts.
Patients whose vital signs do not return to normal 30 minutes after discharge.
Incomplete electrodes after removal.

CED: conducted energy device; ECG: electrocardiogram.
Adapted from Peel M *et al.*[11]

Musculoskeletal injuries

Ligament, muscle, dislocation, and orthopedic injuries have been reported, resulting from intense muscle contractions.[42]

Epidermal burns

Occasionally, small epidermal burns may appear at electrode impact sites, due to electrical current passing through the skin.[6]

Extensive burns

Several cases of severe or even fatal burns have been reported following Taser discharge, typically when the operator was unaware that the subject had been previously sprayed with flammable substances.[49]

SECONDARY COMPLICATIONS

These are linked to electrode impact and falls caused by neuromuscular incapacitation.

Wounds from electrode impact

– Skin lesions: usually two round, erythematous marks of 2–5 mm in diameter.[1]

– Ocular injuries: impact to or near the eye can cause partial or total vision loss.[50,51]

– Vulnerable anatomical regions: areas such as the face, neck, cervical region, breasts, groin, genitals (pelvic triangle), or sites of preexisting injury require special caution.[52,53]

– Probe fragments: part of a probe may remain embedded in the body after electrode removal, requiring careful inspection.[11]

Injuries from falls

– Head trauma: can result in high morbidity and mortality, potentially causing brain injury or death.[54]

– Bone fractures: various types and locations have been reported, notably facial and vertebral fractures, which, due to displacement, may lead to neurological or spinal compromise.[55]

Discussion

Findings from this systematic review suggest a relatively safe physiological and clinical profile for Taser use in

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healthy individuals, though not without risk—particularly in complex clinical situations or predisposed patients.[8]

Physiologically, the effects of the Taser derive from its ability to induce temporary neuromuscular incapacitation by stimulating motor and sensory nerves.[21,22] Tasers are effective even in subjects with high pain tolerance, such as those under stimulant intoxication or extreme agitation.[1,2,5,23] However, transient disorientation may occur immediately after discharge,[13] which, while brief, could affect post-intervention assessment—especially after repeated exposure or in neurologically vulnerable individuals.

Cardiovascular effects such as transient systolic blood pressure increase without ECG or troponin abnormalitiesindicate that, in healthy subjects, the hemodynamic impact is mild and short-lived.[14,17-21]

The potential of Tasers to trigger malignant arrhythmias appears minimal, as lethal electrical effects depend on amperage rather than voltage. The Taser's current (2.1 mA) is well below the 75–100 mA alternating current required to induce ventricular fibrillation.[10,11]

Nevertheless, the clinical impact may differ in patients with cardiac comorbidities or implantable devices, where some studies suggest lowered activation thresholds but without strong evidence of severe adverse effects. Pacemakers, per international standards, are designed to withstand semi-automatic external defibrillators (SAEDs), which deliver 150–400 J at 30–40 amperes. A Taser generates only 0.36 J and 2.1 mA, far below SAED output; thus, it should not affect pacemaker function.[42] Still, further studies in specific populations are warranted due to limited data.

Hematologic and biochemical parameters generally remain stable. Studies report no significant alterations in red cells, hematocrit, platelets, or markers such as CA or alkaline phosphatase. In fact, Kroll *et al*.[20] observed a decrease in both markers 24 hours post-exposure, ruling out systemic inflammation or secondary hepatic damage. Similarly, Kroll *et al*.[24] found no changes in platelet counts, hematocrit, or RBCs, concluding that thrombotic or cardiovascular risk after Taser exposure is minimal.

Complications can be divided into primary (electrical) and secondary (contextual). The former include rare cases of ventricular arrhythmia[30,31,40] acute coronary syndrome,[24] stroke,[24,44] spontaneous abortion,[45] and rhabdomyolysis[48]—usually in the presence of predisposing factors like drug use, psychiatric disorders,[32] sympathetic hyperstimulation (EDS), or multiple exposures.[1]

A particularly relevant issue is the potential association between Tasers and death in EDS patients, a complex clinical state often involving violent resistance, hyperthermia, and pain tolerance. While Taser discharges are not a direct cause of death, they may act as aggravating factors.[38] This highlights the need for specific police and medical protocols in suspected EDS cases.

Likewise, proper training of authorized personnel for the use of the Taser is essential. This training should include not only operational and safe-use aspects of the device but also knowledge of the situations in which its application is contraindicated. Among these are scenarios in which the individual to be restrained has been in contact with flammable substances or has previously sprayed themselves with volatile chemical products. In such cases, the use of the Taser may cause ignition of these substances, resulting in extensive and extremely severe burns.[49]

Regarding secondary complications, there is a notable risk of cranioencephalic trauma[54] and fractures due to falls during sudden incapacitation.[55] Likewise, the impact of the electrodes can cause cutaneous,[1] ocular,[50] and sensitive-area injuries[52,53] highlighting the importance of properly assessing impact sites.

From a clinical and ethical standpoint, these findings reinforce the need to use the Taser with proportionality criteria and only in contexts where its application is justified to preserve life or physical integrity.[7] Furthermore, post-use medical monitoring is recommended, especially in cases of multiple discharges, thoracic application, or in individuals with preexisting conditions.[18]

Medical response protocol

Taser use involves physiological and clinical risks that justify the presence of an advanced life support (ALS) ambulance at the scene.[16,56] This intervention should be coordinated with police command, and medical personnel should wear maximum protective gear against potential weapons.[56]

Police officers should also be trained in basic life support (BLS) and ideally carry a SAED.[1,29]

Before the discharge

While remaining in a safe zone, health care providers should gather information about the individual's medical history, focusing on substance use and physical or mental conditions that could influence their clinical state.[56]

After the discharge

Physical contact with the individual should not occur until it is confirmed that the device has been turned off and the cartridge removed from the Taser,[11] and that the subject has been safely restrained and secured.

The following steps should then be taken:[19,57]

– Initial patient assessment.

– Monitoring of vital signs: temperature (important for ruling out excited delirium syndrome), blood pressure, heart rate, and respiratory rate. Also assess oxygen saturation, capillary glucose, pupillary response, and Glasgow Coma Scale score.

– Electrocardiogram (ECG) in patients with cardiac history or thoracic impacts.[21] Particular attention should be paid to the QT interval, as its prolongation is associated with an increased risk of ventricular arrhythmias.[19]

– Secondary evaluation, assessing for trauma resulting from the fall after discharge, at the same or a different level.

– Assessment of the need for sedation in patients at risk of self-harm, aggression toward responders, or requiring physical restraint. This group should include patients

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with EDS (characterized by agitation, extreme exhaustion, drug use, or intense physical struggle) to reduce morbidity and mortality.[58]

– Application of basic and advanced life support (BLS and ALS) according to the patient's clinical status.

Electrode removal should be performed by healthcare personnel as soon as possible to minimize associated injuries and infection risk, once serious pathology has been ruled out — except when electrodes interfere with life support procedures, in which case they must be removed immediately[7]. Before removal, the site and number of electrode impacts should be evaluated.[19]

The procedure varies depending on the device model. In models prior to the Taser 7, the conducting wire should be cut, the area stabilized, and the electrode pulled firmly at a 90° angle.[19] For the Taser 7 model, the use of its plastic housing is recommended.[11,19]

After extraction, the integrity of the electrodes must be verified. If any electrode is incomplete, the patient should be referred to a hospital. Minor wounds should be cleaned, covered with dressings, and any bleeding controlled with light pressure.[11,19]

If the electrodes were already removed before the health care team's arrival, the integrity of the electrodes and the resulting injuries should be examined.

All interventions must be fully documented, including the location of the electrodes and the removal procedure. Electrodes should be treated as biological sharps and stored appropriately under police custody.[19]

Finally, if the patient does not meet hospital referral criteria (Table 3), they will remain under police responsibility. Otherwise, the patient must be accompanied during transport, ensuring appropriate restraint measures at all times.[19]

Conclusions

Tasers are low-lethality incapacitating weapons, but not without risk, especially in complex clinical situations. Current evidence supports their efficacy in immediate incapacitation without causing permanent harm in most cases. Their increasing use by law enforcement requires health care professionals to understand their clinical effects and to act under protocols that ensure safe and coordinated intervention. Complications are usually related to predisposing factors or secondary injuries from falls. Therefore, the presence of healthcare personnel, the availability of a SAED, and life-support training for police officers are recommended. Despite existing studies, further research is needed on the adverse effects, potential risks, and appropriate medical management in these situations.

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Limitations: This review was not preregistered on platforms such as PROSPERO. Although an internal protocol was followed, the lack of registration represents a methodological limitation, potentially increasing reporting bias.
Grey literature (e.g., technical reports, legal records, or police databases) on Taser use was not included, which may have limited comprehensiveness.

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REFERENCES

1. Aguilar Pallarès A, Morante Barragán JF, Novelle Rodríguez M, Subirana Domènech M. Armas eléctricas: ¿qué sabemos? ¿qué ignoramos? Cuadernos de Medicina Forense. 2013;19:75-86.
2. Hallett N, Duxbury J, McKee T, Harrison N, Haines A, Craig E, et al. Taser use on individuals experiencing mental distress: An integrative literature review. J Psychiatr Ment Health Nurs. 2021;28:56-71.
3. Smith MR, Kaminski RJ, Rojek J, Alpert GP, Mathis J. The impact of conducted energy devices and other types of force and resistance on officer and suspect injuries. Policing: An International Journal. 2007;30:423-46.
4. LeClair TG, Meriano T. Taser and Conducted Energy Weapons. J Spec Oper Med. 2015;15:83-8.
5. Jauchem JR. TASER® conducted electrical weapons: misconceptions in the scientific/medical and other literature. Forensic Sci Med Pathol. 2015;11:53-64.
6. Bozeman WP, Hauda WE, Heck JJ, Graham DD, Martin BP, Winslow JE. Safety and Injury Profile of Conducted Electrical Weapons Used by Law Enforcement Officers Against Criminal Suspects. Ann Emerg Med. 2009;53:480-9.
7. Manhas NS, Stahl D, Schellenberg M, Gholamrezanezhad A. Non-lethal weapon: Injury patterns and imaging correlates for firearm alternatives. Clin Imaging. 2021;79:165-72.
8. Stevenson R, Drummond-Smith I. Medical implications of Conducted Energy Devices in law enforcement. J Forensic Leg Med. 2020;73:101948.
9. Roca G, Martin L, Borraz D, Serrano L, Linam B. A Spanish Intentional Mass-Casualty Incidents Medical Response Model. Delphi Consensus. J Spec Oper Med. 2020;20:95-9.
10. Scientific Advisory Committee on the Medical Implications of Less-Lethal Weapons (SACMILL). Statement on the Medical Implications of the TASER 7TM Conducted Energy Device System Key points [Internet]. 2020. (Accessed 1 March 2025). Available at: www.gov.uk/government/organisations/science-advisory-committee-on-the-medical-implications-of-less-lethal-weapons
11. Peel M, Tremlett D. Assessing and managing people exposed to conducted energy device (Taser) discharge. Emerg Nurse. 2022;30:16-23.
12. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas. Rev Esp Cardiol. 2021;74:790-9.
13. Dawes D, Ho J, Vincent AS, Nystrom P, Driver B. The neurocognitive effects of a conducted electrical weapon compared to high intensity interval training and alcohol intoxication - implications for Miranda and consent. J Forensic Leg Med. 2018;53:51-7.
14. Vilke GM, Sloane CM, Suffecool A, Kolkhorst FW, Neuman TS, Castillo EM, et al. Physiologic effects of the TASER after exercise. Acad Emerg Med. 2009;16:704-10.
15. Vilke GM, Sloane CM, Bouton KD, Kolkhorst FW, Levine SD, Neuman TS, et al. Physiological Effects of a Conducted Electrical Weapon on Human Subjects. Ann Emerg Med. 2007;50:569-75.
16. Baliatsas C, Gerbecks J, Dückers MLA, Yzermans CJ. Human Health Risks of Conducted

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Electrical Weapon Exposure: A Systematic Review. JAMA Netw Open. 2021;4:1-14.
17. Kroll MW. Physiology and pathology of TASER® electronic control devices. J Forensic Leg Med. 2009;16:173-7.
18. Vilke G, Chan T, Bozeman WP, Childers R. Emergency Department Evaluation After Conducted Energy Weapon Use: Review of the Literature for the Clinician. J Emerg Med. 2019;57:740-6.
19. Peel M. Assessment of people who have been tasered. Emerg Nurse. 2017;25:22-8.
20. Kroll MW, Witte KK, Ritter MB, Kunz SN, Luceri RM, Criscione JC. Electrical weapons and rhabdomyolysis. Forensic Sci Med Pathol. 2021;17:58-63.
21. Ho JD, Dawes DM, Kunz SN, Klein LR, Driver BE, DeVries PA, et al. The physiologic effects of a new generation conducted electrical weapon on human volunteers at rest. Forensic Sci Med Pathol. 2020;16:406-14.
22. Ho JD, Dawes DM, Chang RJ, Nelson RS, Miner JR. Physiologic effects of a new-generation conducted electrical weapon on human volunteers. J Emerg Med. 2014;46:428-35.
23. Jauchem JR. Exposures to conducted electrical weapons (including taser® devices): How many and for how long are acceptable? J Forensic Sci. 2015;60:S116-29.
24. Kroll MW, Witte KK, Kunz SN, Luceri RM, Criscione JC. Electrical weapons, hematocytes, and ischemic cardiovascular accidents. J Forensic Leg Med. 2020;73:101990.
25. Zipes DP. Sudden cardiac arrest and death following application of shocks from a TASER electronic control device. Circulation. 2012;125:2417-22.
26. Stopyra JP, Winslow JE, Fitzgerald DM, Bozeman WP. Intracardiac electrocardiographic assessment of precordial TASER shocks in human subjects: A pilot study. J Forensic Leg Med. 2017;52:70-4.
27. Rich B, Brophy JM. Estimating the Risk of Cardiac Mortality After Exposure to Conducted Energy Weapons. Can J Cardiol. 2015;31:1439-46.
28. Zipes DP. Can TASER Electronic Control Devices Cause Cardiac Arrest? Circulation. 2014;129:101-11.
29. White RD, Hankins DG, Bugliosi TF. Seven years' experience with early defibrillation by police and paramedics in an emergency medical services system. Resuscitation. 1998;39:145-51.
30. Cao M, Shinbane JS, Gillberg JM, Saxon LA. Taser-induced rapid ventricular myocardial capture demonstrated by pacemaker intracardiac electrograms. J Cardiovasc Electrophysiol. 2007;18:876-9.
31. Kim PJ, Franklin WH. Ventricular Fibrillation after Stun-Gun Discharge. N Engl J Med. 2005;353:958-9.
32. O'Brien AJ, Thom K. Police use of TASER devices in mental health emergencies: A review. Int J Law Psychiatry. 2014;37:420-6.
33. Ordog GJ, Wasserberger J, Schlater T, Balasubramanium S. Electronic gun (Taser®) injuries. Ann Emerg Med. 1987;16:73-8.
34. Strote J, Hutson HR. Taser use in Restraint-related Deaths. Prehospital Emergency Care. 2006;1:447-50.
35. Gonin P, Beysard N, Yersin B, Carron PN. Excited Delirium: A Systematic Review. Acad Emerg Med. 2018;25:552-65.
36. Ho JD, Dawes DM, Nelson RS, Lundin EJ, Ryan FJ, Overton KG, et al. Acidosis and catecholamine evaluation following simulated law enforcement «use of force» encounters. Acad Emerg Med. 2010;17:e60-8.
37. Gerold KB, Gibbons ME, Fisette RE, Alves D. Review, clinical update, and practice guidelines for excited delirium syndrome. J Spec Oper Med. 2015;15:62-9.
38. Kroll MW, Hail SL, Kroll RM, Wetli CV, Criscione JC. Electrical weapons and excited delirium: shocks, stress, and serum serotonin. Forensic Sci Med Pathol. 2018;14:478-83.
39. Kunz SN, Adamec J. A comparative brief on conducted electrical weapon safety. Wien Med Wochenschr. 2018;169:185-92.
40. Haegeli LM, Sterns LD, Adam DC, Leather RA. Effect of a Taser shot to the chest of a patient with an implantable defibrillator. Heart Rhythm. 2006;3:339-41.
41. Paninski RJ, Marshall ME, Link MS. ICD oversensing caused by TASER. J Cardiovasc Electrophysiol. 2013;24:101.
42. Kunz SN, Calkins H, Adamec J, Kroll MW. Cardiac and skeletal muscle effects of electrical weapons: A review of human and animal studies. Forensic Sci Med Pathol. 2018;14:358-66.
43. Bui ET, Sourkes M, Wennberg R. Generalized tonic-clonic seizure after a taser shot to the head. CMAJ. 2009;180:625-6.
44. Bell N, Moon M, Dross P. Cerebrovascular accident (CVA) in association with a Taser-induced electrical injury. Emerg Radiol. 2014;21:211-3.
45. Mehl LE. Electrical injury from tasering and miscarriage. Acta Obstet Gynecol Scand. 1992;71:118-23.
46. Jauchem JR. Pathophysiologic changes due to TASER® devices versus excited delirium: Potential relevance to deaths-in-custody? J Forensic Leg Med. 2011;18:145-53.
47. Dawes DM, Ho JD, Reardon RF, Miner JR. The Physiologic Effects of Multiple Simultaneous Electronic Control Device Discharges. J Emerg Med. 2009;37:209-10.
48. Gleason J, Ahmad I. TASER® electronic control device-induced rhabdomyolysis and renal failure: A case report. J Clin Diagn Res. 2015;9:HD01-2.
49. Kroll MW, Ritter MB, Williams HE. Fatal and non-fatal burn injuries with electrical weapons and explosive fumes. J Forensic Leg Med. 2017;50:6-11.
50. Kroll MW, Ritter MB, Kennedy EA, Siegal NK, Shinder R, Brave MA, et al. Eye injury from electrical weapon probes: Mechanisms and treatment. Am J Emerg Med. 2019;37:427-32.
51. Kroll MW, Ritter MB, Kennedy EA, Silverman NK, Shinder R, Brave MA, et al. Eye injuries from electrical weapon probes: Incidents, prevalence, and legal implications. J Forensic Leg Med. 2018;55:52-7.
52. Campbell F, Clark S. Penetrating facial trauma from a Taser barb. Br J Oral Maxillofac Surg. 2019;57:188-9.
53. Theisen K, Slater R, Hale N. Taser-related testicular Trauma. Urology. 2016;88:e5.
54. Kroll MW, Adamec J, Wetli CV, Williams HE. Fatal traumatic brain injury with electrical weapon falls. J Forensic Leg Med. 2016;43:12-9.
55. Tyagi A, Gill A, Felton B. Thoracic Compression Fracture as a Result of Taser® Discharge. Clin Pract Cases Emerg Med. 2017;1:319-22.
56. Cester-Martínez A, Serrano-Lasaosa L, Borraz-Clares D. Medical care in a police intervention with conducted electrical weapons: Zaragoza (Spain) fire department protocol. Prehosp Disaster Med. 2021;36:639-44.
57. Bleetman A, Hepper AE, Sheridan B. The use of TASER devices in UK policing: An update for clinicians following the recent introduction of the TASER 7. Emerg Med J. 2023;40:147-50.
58. Vilke GM, Debard ML, Chan TC, Ho JD, Dawes DM, Hall C, et al. Excited delirium syndrome (ExDS): Defining based on a review of the Literature. J Emerg Med. 2012;43:897-905.

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