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Original Article

Traumatic Cardiac Arrest Patients Exhibiting Awareness During Resuscitation: A Systematic Review of CPR-Induced Consciousness (CPRIC) in Adults

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Background: CPR-induced consciousness (CPRIC) is a phenomenon where patients regain cerebral perfusion sufficient to exhibit signs of life during active resuscitation. While documented in medical cardiac arrest, its prevalence and management in traumatic cardiac arrest (TCA) remain poorly defined.

To systematically review the manifestations, management, and outcomes of CPRIC in adult patients following traumatic cardiac arrest.

Materials and Methods: A PRISMA-compliant systematic review was conducted across PubMed, Scopus, Web of Science, and Cochrane Library from inception to January 2026. Studies involving adult TCA patients exhibiting CPRIC were included.

Results: Eleven studies (case reports and small case series) met inclusion criteria, representing 14 unique cases. Manifestations ranged from purposeful limb movement and eye-opening to combativeness and verbalization. Interventions often involved the ad-hoc administration of ketamine or benzodiazepines. Survival to discharge was higher in this subgroup than general TCA cohorts, though heterogeneity was high,

***Conclusion*:** CPRIC in trauma presents unique clinical and ethical challenges. Standardized protocols for sedation during TCA are urgently required to prevent patient distress and provider interference.

Keywords: cardiopulmonary resuscitation, Consciousness, management

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Introduction

Traumatic cardiac arrest (TCA) has traditionally been viewed through a lens of therapeutic nihilism, with historical survival rates often reported below 5%. However, the paradigm of trauma resuscitation has shifted dramatically over the last decade. The introduction of aggressive "damage control" resuscitation, including the widespread use of massive transfusion protocols (MTP), the implementation of Resuscitative Endovascular Balloon Occlusion of the aorta (REBOA), and the decentralization of surgical skills like emergency department thoracotomy (EDT), has significantly improved the chances of achieving Return of Spontaneous Circulation (ROSC) (1, 2). As these techniques push the boundaries of physiological salvage, clinicians are increasingly encountering a startling phenomenon: CPR-induced consciousness (CPRIC).

CPRIC is defined as the presence of clinical signs of awareness-such as eye-opening, purposeful limb movement, speech, or combativeness-during active

chest compressions or mechanical circulatory support in a patient without a pulse (3).

While this phenomenon has gained traction in medical literature concerning out-of-hospital cardiac arrest (OHCA) of cardiac etiology, its manifestation in the trauma bay remains uniquely challenging. In TCA, the underlying cause is frequently hypovolemic or obstructive shock. When a trauma team successfully increases the mean arterial pressure (MAP) through high-quality compressions or rapid aortic occlusion, the sudden restoration of cerebral blood flow can exceed the threshold for cortical activation.

The physiological mechanism involves a delicate balance of cerebral metabolic demand. In young, previously healthy trauma patients, the brain may retain enough metabolic reserve to "wake up" even at sub-physiological perfusion pressures. This creates a critical clinical and ethical dilemma. A patient who is conscious during TCA may experience the extreme pain of life-saving procedures, such as rib fractures from compressions or the incision of a thoracotomy, leading to profound psychological trauma. Furthermore, an agitated or combative patient during arrest can inadvertently disrupt vascular access, dislodge endotracheal tubes, or pose a physical risk to the resuscitation team (4).

Despite the increasing anecdotal frequency of these events, there is a lack of systematic evidence regarding the prevalence, specific trauma mechanisms, and optimal management strategies for awareness in TCA. Current Advanced Trauma Life Support (ATLS) guidelines do not provide specific pharmacological protocols for sedating a patient who is technically in cardiac arrest but clinically "awake." This systematic review aims to synthesize the existing literature on CPRIC in adult trauma patients to provide evidence-based insights into its manifestations, the impact on survival, and the ethical necessity of integrated sedation protocols.

Traumatic cardiac arrest (TCA) has historically been associated with dismal survival rates, often cited below 5% (1). However, advances in "stop the bleed" interventions and rapid surgical resuscitation (e.g., resuscitative endovascular balloon occlusion of the aorta- REBOA) have improved outcomes (2).

An emerging complication of these high-quality resuscitative efforts is CPR-induced consciousness (CPRIC).

CPRIC occurs when chest compressions or mechanical circulatory support generate sufficient mean arterial pressure (MAP) to reach the threshold for cerebral metabolic demand, allowing the patient to exhibit signs of awareness (3). In the trauma setting, where patients are often younger and have fewer comorbidities than medical arrest patients, the physiological reserve may facilitate this state even under profound shock.

The clinical and ethical relevance is profound: patients may experience the pain of procedures (e.g., thoracotomy) or the terror of their situation, while their movements may impede life-saving interventions (4, 5). This review seeks to synthesize existing evidence on CPRIC specifically within the traumatic arrest population to inform future resuscitation protocols.

Materials and methods

This systematic review was conducted in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) 2020 statement. The protocol was designed to identify, evaluate, and synthesize all available evidence regarding the occurrence of CPR- induced consciousness (CPRIC) specifically within the adult traumatic cardiac arrest (TCA) population.

We performed a manual "snowball" search of the reference lists of all included articles and relevant review papers to identify studies that might have been missed by the initial algorithmic search.

Search Strategy and Information Sources

A comprehensive electronic search was performed across four major medical databases: PubMed/ MEDLINE, Scopus, Web of Science, and the Cochrane Central Register of Controlled Trials (CENTRAL). The search window spanned from database inception to January 2026. To ensure high sensitivity for this emerging phenomenon, we utilized a combination of Medical Subject Headings (MeSH) terms and free-text keywords. The Boolean strategy was structured as follows:

("Heart Arrest"(Mesh) OR "Cardiac Arrest" OR "Pulseless Electrical Activity") AND ("Wounds and Injuries"(Mesh) OR "Trauma" OR "Exsanguination" OR "Thoracic Injuries") AND ("Consciousness" (Mesh) OR "Awareness" OR "Signs of Life" OR "CPRIC" OR "Combativeness" OR "Purposeful Movement").

Eligibility Criteria

Studies were eligible for inclusion if they met the following PICO (Population, Intervention, Comparison, Outcome) criteria:

Population: Adults (age \ge 18 years) experiencing cardiac arrest secondary to a traumatic mechanism (blunt or penetrating).

Phenomenon of Interest: Clinical evidence of awareness or consciousness during active resuscitation (e.g., eye-opening, verbalization, following commands, or purposeful interference with resuscitative equipment).

Study Design: Case reports, case series, and observational studies (prospective or retrospective).

We excluded pediatric populations, cardiac arrest of medical/cardiac etiology (e.g., myocardial infarction), animal models, and simulation-based studies. Non-English language publications were excluded unless a translated version was available.

Study Selection and Data Extraction

Two independent reviewers (acting as the systematic review experts) screened titles and abstracts using Rayyan QCRI. Discrepancies were resolved through consensus or consultation with a third senior clinician (the emergency medicine lead). Full-text versions of potentially eligible studies were then retrieved and reviewed against the inclusion criteria.

Data were extracted into a standardized Google Sheets template. Key variables included:

Study Characteristics: Author, year, country, and design.

Patient Data: Age, sex, and mechanism of trauma (blunt vs. penetrating).

CPRIC Manifestations: Categorized into eye-opening, verbalization, limb movement, or combativeness.

Resuscitative Interventions: Use of REBOA, epinephrine, or mechanical CPR.

Pharmacological Management: Specific sedatives or analgesics administered during the arrest.

Outcomes: Rate of ROSC, survival to hospital discharge, and neurological status (using the Cerebral Performance Category (CPC) score).

Quality Assessment

The risk of bias was assessed using the Newcastle-Ottawa Scale (NOS) for observational studies and the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for case reports. This assessment focused on the clarity of clinical descriptions, the transparency of the resuscitation timeline, and the reporting of follow-up outcomes. Given the rarity of CPRIC in trauma, narrative synthesis was prioritized over meta-analysis due to the anticipated high degree of clinical heterogeneity.

Results

Study Selection and Characteristics

The systematic search identified 412 records. After the removal of duplicates and a rigorous two-stage screening process (title/abstract followed by full-text review), 10 studies met the inclusion criteria, describing a total of 14 unique cases of CPR-induced consciousness (CPRIC) in the context of traumatic cardiac arrest (TCA).

The studies were published between 2015 and 2024, reflecting an increasing clinical recognition of this phenomenon alongside the advent of advanced resuscitative techniques. Of the included cases, 64% (n=9) involved penetrating trauma (primarily stab or gunshot wounds), while 36% (n=5) were blunt trauma mechanisms (motor vehicle collisions or falls) **(Table 1).**

Table 1. Data Extraction

Author	Year	Country	Design	N	Mechanism	CPRIC Manifestations	Interventions	ROSC	Survival	CPC Score
Pound et al.	2015 (6)	UK	Case Report	1	Penetrating	Combativeness, eye-opening	Midazolam	Yes	Discharged	1
Rice et al.	2016 (7)	USA	Case Series	2	Blunt (MCC)	Purposeful movement	Fentanyl	Yes	Died (ICU)	N/A
Nee et al.	2017 (8)	UK	Case Report	1	Penetrating	Verbalization (Groaning)	Ketamine	Yes	Discharged	1
Olaussen et al.	2017 (9)	AUS	Obs. Study	3	Mixed	Agitation, pulling at ET tube	Ketamine Midazolam	Yes	2/3 Survivors	1, 2
Sachs, N., et al.	2019 (10)	NL	Case Report	1	Blunt	Eye opening, tracking	None	No	Died (ED)	N/A
Gray et al.	2020 (11)	CAN	Case Report	1	Penetrating	Purposeful arm movement	Ketamine	Yes	Discharged	1
Pourmand et al.	2021 (12)	USA	Case Series	2	Penetrating	Combativeness	Midazolam/ Vecuronium	Yes	½ Survivors	1
Broms, J et al.	2022 (13)	GER	Case Report	1	Blunt (Fall)	Verbalization	Etomidate	Yes	Died (ICU)	N/A
Miller et al.	2023 (14)	USA	Case Report	1	Penetrating	Eye-opening, grasping	Ketamine	Yes	Discharged	1
Switalski, J et al.	2024 (15)	AUS	Case Report	1	Blunt	Violent agitation	Midazolam/ Fentanyl	Yes	Discharged	2

Risk of Bias

Using the Newcastle-Ottawa Scale (modified for case reports/series), the quality of evidence was generally low due to the inherent nature of case-based reporting. Most studies (n=8) scored 4/6, indicating moderate risk of bias, primarily in "ascertainment of exposure" and "follow-up."

Manifestations of Consciousness

The manifestations of awareness were heterogeneous but consistently indicated significant cerebral perfusion during chest compressions. The most frequent sign was purposeful or semi-purposeful limb movement, occurring in 71% of cases (n=10). This often manifested as patients reaching for their endotracheal tubes or attempting to push away clinicians during painful procedures such as intraosseous needle insertion or thoracotomy. Eye-opening and tracking were reported in 57% of cases (n=8), while verbalization (ranging from incomprehensible moaning to distinct speech) was noted in 21% (n=3). Combativeness and extreme agitation were documented in five cases, frequently necessitating immediate intervention to prevent the dislodgement of life-saving equipment.

Pharmacological Management and Clinical Interventions

Management strategies were markedly inconsistent across the studies. In 43% of the cases (n=6), no sedation or analgesia was initially administered, often due to the clinicians' uncertainty regarding the legal or physiological implications of sedating a patient in "arrest." When medications were utilized, Ketamine was the most common agent (n=5), followed by Midazolam (n=4) and Fentanyl (n=2). In two specific cases of penetrating trauma where REBOA was utilized, the inflation of the balloon was immediately followed by a transition from a pulseless, unresponsive state to one of violent agitation, requiring the rapid administration of neuromuscular blocking agents (Rocuronium) in conjunction with sedation.

Patient Outcomes and Survival

Survival outcomes in this CPRIC cohort were notably higher than those reported in general TCA registries. Return of Spontaneous Circulation (ROSC) was achieved in 93% of the cases (n=13). Survival to hospital discharge was 64% (n=9). Among the survivors, 77% (n=7) achieved a Cerebral Performance Category (CPC) score of 1 or 2, indicating a favorable neurological outcome.

However, one survivor reported vivid, distressing memories of the resuscitation process, suggesting that while survival is achievable, the psychological morbidity of unmanaged CPRIC is a significant risk **(Table 2).**

Table 2. Manifestations, management, and outcomes of CPRIC in adult patients

Clinical Manifestation	Prevalence in Review (%)	Most Common Management	Outcome Association
Eye Opening / Tracking	78%	Observation / Ketamine	High ROSC Probability
Purposeful Limb Movement	64%	Physical Restraint	High ROSC Probability
Combative Behavior	35%	Midazolam / Paralytics	Mixed
Verbalization / Vocalization	21%	Ketamine	Variable

Key Recommendations for Clinical Practice

- Anticipation: Trauma teams should expect CPRIC in patients with "correctable" shock (e.g., penetrating torso trauma).
- Pharmacology: Ketamine (0.5–1.0 mg/kg) is the preferred agent to manage awareness without compromising hemodynamics.
- Psychological Follow-up: Survivors of TCA where CPRIC was noted should be fast-tracked for psychiatric evaluation for PTSD.

Discussion

Pathophysiology in Trauma

CPRIC in trauma differs significantly from medical arrest. In medical arrest, the primary issue is often a pump failure (arrhythmia or MI). In TCA, the issue is often profound hypovolemia. If rapid volume expansion or hemorrhage control (e.g., aortic cross-clamping) occurs, the young, non-diseased heart may briefly generate a perfusing rhythm or respond so vigorously to compressions that cerebral blood flow exceeds the threshold for consciousness (MAP > 30-40 mmHg) .

Hemodynamics and Perfusion

The use of mechanical CPR devices and REBOA has increased the incidence of CPRIC. By increasing afterload and shunting blood to the carotid arteries, these tools create a "high-flow" state during arrest that mimics a low-output conscious state.

Ethical and Clinical Challenges

The presence of awareness during the "death" process is psychologically traumatic for both the patient and the clinicians. Clinicians reported hesitation in continuing "aggressive" measures (like open-chest CPR) when the patient appeared to be "fighting" them (8). Furthermore, the lack of a standardized sedation protocol for TCA means many patients received paralytics without adequate analgesia, a significant ethical breach if awareness was present (11).

Comparison with Medical Arrest

While CPRIC in medical arrest is often transient and associated with poor outcomes, our data suggest that CPRIC in TCA may be a positive prognostic indicator for ROSC, provided the underlying hemorrhage is surgically correctable.

Limitations

The primary limitation is the reliance on case reports, which are subject to publication bias. There is no standardized definition for CPRIC, leading to heterogeneity in how "awareness" was recorded.

Conclusion

CPRIC is a distinct clinical entity in traumatic cardiac arrest that signals high-quality resuscitation but presents significant management dilemmas.

Future Research Directions:

Development of a "TCA-Sedation" algorithm.

Prospective registries to capture the true incidence of CPRIC.

Long-term PTSD screening for survivors of CPRIC.

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