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Review

CPR-related cognitive activity, consciousness, awareness and recall, and its management: A scoping review

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Abstract

Background: There are increasing numbers of reports of cognitive activity, consciousness, awareness and recall related to cardiopulmonary resuscitation (CPR) and interventions such as the use of sedative and analgesic drugs during CPR.

Objectives: This scoping review aims to describe the available evidence concerning CPR-related cognitive activity, consciousness, awareness and recall and interventions such as the use of sedative and analgesic drugs during CPR.

Methods: A literature search was conducted of Medline, Embase and CINAHL from inception to 21 October 2021. We included case studies, observational studies, review studies and grey literature.

Results: We identified 8 observational studies including 40,317 patients and 464 rescuers, and 26 case reports including 33 patients. The reported prevalence of CPR-induced consciousness was between 0.23% to 0.9% of resuscitation attempts, with 48–59% of experienced professional rescuers surveyed estimated to have observed CPR-induced consciousness. CPR-induced consciousness is associated with professional rescuer CPR, witnessed arrest, a shockable rhythm, increased return of spontaneous circulation (ROSC), and survival to hospital discharge when compared to patients without CPR-induced consciousness. Few studies of sedation for CPR-induced consciousness were identified. Although local protocols for treating CPR-induced consciousness exist, there is no widely accepted guidance.

Conclusions: CPR-related cognitive activity, consciousness, awareness and recall is uncommon but increasingly reported by professional rescuers. The data available was heterogeneous in nature and not suitable for progression to a systematic review process. Although local treatment protocols exist for management of CPR-induced consciousness, there are no widely accepted treatment guidelines. More studies are required to investigate the management of CPR-induced consciousness.

Keywords: Cardiac arrest, Cardiopulmonary resuscitation, Consciousness, Awareness, Post-traumatic stress disorder, Near death experience

Introduction

Cardiopulmonary resuscitation (CPR) related cognitive activity, consciousness, awareness, and recall is increasingly reported. Cases include documentation of patients moving, perceived consciousness and awareness, as well as recall of CPR events by survivors.[1] Although in the past the poorly defined umbrella term of 'near death experiences'[2] has been used to refer to cardiac arrest reported experiences, these descriptions do not adequately describe the breadth of these experiences.[3]

There is no current consensus or guidance on how CPR-induced consciousness should be managed. While some settings have developed local protocols most professional

Abbreviations: ALS, Advanced life support, CPR, Cardiorespiratory resuscitation, ED, Emergency Department, EMS, Emergency medical service, GCS, Glasgow coma scale, ICU, Intensive care unit, IHCA, In-hospital cardiac arrest, ILCOR, International Liaison Committee on Resuscitation, OHCA, Out-of-hospital cardiac arrest, OR, Odds Ratio, PTSD, Post-traumatic stress disorder, ROSC, Return of spontaneous circulation, VF, Ventricular fibrillation, VT, Ventricular tachycardia, pVT, pulseless ventricular tachycardia

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rescuers have no guidance on how to manage CPR-induced consciousness.

The Advanced Life Support (ALS) Task Force of the International Liaison Committee on Resuscitation (ILCOR) considered it timely to undertake a scoping review to identify literature related to cognitive activity, consciousness, awareness and recall of patients who received CPR and the impact of potential interventions such as the use of sedative and analgesic drugs during resuscitation. A scoping review rather than a systematic review was undertaken in order to systematically describe the limited available evidence using a broad literature search and to identify current interventions and knowledge gaps.

Methods

This review was undertaken on behalf of the ILCOR ALS Task Force as part of its continuous evidence evaluation process, and the protocol developed adhered to the ILCOR guidance on Task Force scoping reviews.[4] It was drafted using the preferred reporting items for systematic reviews and Meta-analysis protocols extension for Scoping Reviews (PRISMA-ScR).[5]

The following population, interventions, comparators and outcomes were decided *a priori:*

Population: Adults in any setting with consciousness during CPR.

Intervention: Sedation, analgesia, or any other intervention to prevent consciousness.

Comparison: No specific intervention for consciousness.

Outcomes: Any patient clinical outcome. Arrest outcomes and psychological wellbeing post arrest.

Other relevant outcomes identified from the review where included such as rescuer outcomes including, rescuer distress, trauma, and uncertainty.

Eligibility

Study designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) were all eligible for inclusion. For the purpose of the scoping review, we also included review articles, case reports and case series, grey literature and unpublished studies (e.g., conference abstracts, trial protocols). Articles based around the Lazarus phenomenon[6] and cough CPR[7] as well as narrative articles referring to near-death experiences and consciousness were excluded. Children and animal studies were excluded.

Time frame, language and study group: All years and languages were included providing an English title or abstract was given.

Article identification

We searched Medline, Embase, EMcare and CINAHL (via EBSCO) from inception to 26 Nov 2020 with a repeat search conducted on 21 October 2021. The search included keyword and subject terms relating to consciousness or awareness and CPR, and search filters were used to limit to adults and humans. The strategy is outlined in Appendix 1. We also screened reference lists of included papers. Grey literature (including local protocols) was identified by asking ILCOR colleagues to share articles, no specific separate additional search for grey literature was conducted.

Selection of sources of evidence

On receiving the identified articles, they were uploaded onto a standardised review platform (Rayyan) and duplicates identified and resolved within this platform. Article title and abstracts were then reviewed for relevance by two independent task force members (RW and QO) and any deemed to be irrelevant were excluded. Both reviewers and a third reviewer (JS) reviewed those studies where there was initial disagreement. Full text review and initial data extraction was conducted by RW, and checked by QO and JS. Identified articles were grouped as case studies, observational studies, review studies, grey literature and protocols. We included both quantitative and qualitative data from articles.

As this is a scoping review, critical appraisal of sources of evidence and systematic comparison was not conducted.

Data extraction and synthesis

Spreadsheet tables were created and piloted for data extraction using Excel by two reviewers (RW and QO). Different data were extracted for observational studies, case reports, review articles and sedation protocols (see Tables 1–4). Our focus was to identify, where possible, the population; arrest type; evidence of CPR-related cognitive activity, consciousness, awareness and recall; and any management or outcome data. Data were extracted by two reviewers (RW and QO) with oversight from a third author (JS) in an iterative process including discussion on what was relevant to our study.

Studies were grouped by article type and relevant data extracted and synthesised within these groups. A presentation to the ILCOR task-force on 1st Feb 2021 generated discussion of results and guided the authors' narrative discussion presented in this review.

Results

The results of the search strategy are summarised in the PRISMA flow diagram in Fig. 1.

Synthesis of results

We identified observational studies, case studies, review papers and protocols for use of sedation for CPR-induced consciousness. We identified 8 observational studies with a total of 40,317 patients and 464 rescuers, 26 case reports including 33 patients, 3 review papers and 4 sedation regimens (Tables 1–4). The Cohen's kappa for agreement between reviewers at initial screening was 0.85.

Two types of cognitive activity and awareness were identified. The first includes visible signs of consciousness such as combativeness, groaning, and eye opening and was referred to as CPR-induced consciousness. The second, a perception of lucidity with visual and auditory awareness and recall without external signs of consciousness.[9]

Observational studies estimated that CPR-induced consciousness occurred in 0.23% to 0.9% of all CPR attempts with combativeness or agitation reported in 34.6% cases as the most common sign.[10,12] An estimated 48–59% of 'experienced' healthcare professionals reported observing a patient with CPR-induced consciousness during resuscitation. It is unclear whether this high rate reflects the true prevalence of CPR-induced consciousness or the study designs and small sample sizes. Rescuer reports of CPR-induced consciousness interfering with the CPR attempts included

Table 1 – Characteristics and results of observational studies included in review.

Reference	Study Design	Setting	Population	Outcomes Measured	Prevalence of CPR related observations	Characteristics of CPR related observations	Sedation data	Survival data
Patient studies								
Gamper 2004[8]	Prospective Cohort	University Hospital Helsinki 1991–1999	143 cardiac arrest survivors who were discharged with favourable neurological outcome. Arrest type: OHCA $n = 74$ IHCA $n = 69$ Initial rhythm shockable $n = 116$	Sedation and analgesia use Development of PTSD	39 (27%) fulfilled criteria for PTSD*	NA	Bolus sedative and/analgesic in 72% of patients with PTSD and 70% of patients without PTSD. Continuous sedation/analgesia given in 58% of patients with PTSD and 63% without PTSD. No significant association between sedation and development of PTSD.	Only significant pre-indicator for PTSD was younger age
Parnia 2014[9]	Prospective study	Multi centre 25 international hospitals including US, UK and Austrian	140 eligible cardiac arrest survivors interviewed. 101 of these completed a further interview. OHCA/IHCA/ Rhythm not provided	Patient reports of patient recall/ awareness/near-death experience	55 (39%) had Perceptions of awareness and/or memories	46% had detailed memories but no near-death experience. 7% had detailed memories and near-death experience but no auditory/visual awareness or recall 2 % had detailed memories, near-death experience and visual/ auditory awareness and recall**	NA	NA
Olaussen 2017[10]	Retrospective observational	Registry-based data from Victoria, Australia between January 2008 and December 2014	Adult OHCA patients treated by emergency medical services ($n = 16558$)	Prevalence and nature of CPR-induced consciousness Survival outcomes Sedation use	112 incidents of CPR-induced consciousness with increasing frequency (0.3% in 2008 to 0.9% in 2014)	Higher proportion of CPR-induced consciousness patients had: Witnessed arrests by EMS, shockable rhythm, presumed cardiac aetiology Signs of	37.5% received treatment: 1 or more of midazolam, opioids, or muscle relaxants. When stratified by use of these medications, CPR-induced consciousness in unwitnessed/bystander witnessed patients was associated with improved odds of survival to hospital discharge if medications were not given (OR 3.92, 95% CI: 1.66, 9.28; p = 0.002), but did not influence survival if these	CPR-induced consciousness was independently associated with an increased odds of survival to hospital discharge in unwitnessed/bystander witnessed events.

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Table 1 (continued)

Reference	Study Design	Setting	Population	Outcomes Measured	Prevalence of CPR related observations	Characteristics of CPR related observations	Sedation data	Survival data
						consciousness include spontaneous eye opening 20.5%, jaw tone 20.5%, speech 25.9% and/or body movement 87.5%	medications were given (OR 0.97, 95% CI: 0.37, 2.57; p = 0.97)	
Parnia 2019[11]	Prospective study	Multi centre 25 international hospitals including US, UK and Austrian	465 patients experiencing IHCA cardiac arrest	Survival Post survival memory of resuscitation	4 of the 21 survivors interviewed experienced explicit memories (19%)	Internal cognitive activity such as feeling of peace, joy, and perception of family members along with external awareness such as hearing people talking, giving drugs were recorded. 0 identified the visual stimuli set during resuscitation but 1 out of 19 correctly identified the audio stimuli	NA	Out of the 465 patients included 44 (9%) survived
Doan 2020[12]	Retrospective observational	Data from Queensland ambulance service between January 2007 and December 2018	Adult OHCA, where resuscitation attempted ($n = 23011$)	CPR-induced consciousness prevalence Features of CPR-induced consciousness Survival outcomes Sedation used	52 (0.23%) cases of CPR-induced consciousness. CPR-induced consciousness rate of 2.3 per 1000 over a 12-year period.	Higher proportion of CPR-induced consciousness cases happened in public locations, with initial shockable rhythm, witnessed by rescuers. Signs of consciousness include: Combativeness/ agitation 34.6%, groaning 19.2%,	Sedation given 11.5%, 0.5–2.5 mg midazolam (given to 4 patients either alone or with fentanyl), 1 received morphine, 1 ketamine + suxamethonium	Patients with CPR-induced consciousness had higher rates of ROSC, survival to discharge and 30 days. CPR-induced consciousness was not found to be an independent predictor of survival

Table 1 (continued)

Reference	Study Design	Setting	Population	Outcomes Measured	Prevalence of CPR related observations	Characteristics of CPR related observations	Sedation data	Survival data
						Eye opening/ rolling 15.4%, 76.9% showing more than 1 sign		
Rescuer studies								
Olaussen 2016[13]	Cross-sectional study	Survey distributed through social media and word-of-mouth 2 days prior to the Australian Resuscitation Council Conference 2015	100 health care workers of whom 63 responded to CPR-induced consciousness questions	Prevalence and nature of CPR-induced consciousness. Whether CPR-induced consciousness interfered with the resuscitation attempt. Evidence of patient recall. Use of sedation. Optimal management.	59 of 63 respondents had experienced non-interfering CPR-induced consciousness a median of 3 times in their career. 51 of 63 respondents had experienced interfering CPR-induced consciousness a median of 1 time.	NA	59 respondents about management in CPR-induced consciousness (non-interfering): 20% reported using sedation, 7% used paralysing drugs/RSI. When asked about optimum management, 22.4% nothing specific, 39.7% recommended sedation. 57 respondents about management in CPR-induced consciousness (interfering) 38.6% used sedation 1 gave paralysis only. When asked about optimum management, 42.1% sedation only, 21.6% sedation + paralysis/ RSI, 1 paralysis only	15 clinicians reported a total of 26 patients had recall of CPR, but the nature was not specified in this study.
Versteeg 2019[14]	Cross-sectional study	Anonymous questionnaire emailed to staff in 950 bed hospital trust (area not specified)	71 Anaesthetics, ED, ICU physicians	Experience of CPR-induced consciousness Effects of CPR-induced consciousness on treatment and treatment choice used Effects of CPR-induced consciousness on team members	34 (48%) Had multiple experiences with CPR-induced consciousness	>90% reported detrimental effect on care givers. 52% reporting personal discomfort and 7% reporting sleeplessness, nightmares and mood change.	45% used midazolam, 11% ketamine, 4% opioids All worried medication may have negative impact circulation and felt there was a lack of evidence on dose-effects relationship.	NA
Gregory 2020[15]	Cross-sectional study	Survey distributed to paramedics registered in the UK	293 registered paramedics	Reports of rescuer witnessed CPR-induced consciousness/ Nature of CPR-induced	167 (57%) of survey respondents reported witnessing CPR-induced	Signs of consciousness in cases reported by rescuers were most commonly motor (120	NA	NA

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Table 1 (continued)

Reference	Study Design	Setting	Population	Outcomes Measured	Prevalence of CPR related observations	Characteristics of CPR related observations	Sedation data	Survival data
				consciousness. Whether and how CPR-induced consciousness interfered with CPR.	consciousness, of whom 56% reported multiple cases.	reports) eye opening (78 reports) and verbal (62 reports). Interference with CPR was reported by 49.7% of rescuers first cases, falling with further cases. The most common interference was patient resisting clinical interventions (55 reports)		

* PTSD as defined as a Davidson trauma score >40.

** Both patients experiencing memories with near-death experiences and visual/auditory awareness with recall had shockable arrests 1 patient had verified recall.

Table 2 – Characteristics and results of case studies included in review.

Reference	Country	Demographics	Arrest type	Evidence of consciousness	CPR type	Sedation data	Survival data
Bernier 1962[16]	USA	63 y/o male	IHCA, VF	Rescuer reported	Manual	None	Survival at 1 year
Miller 1961[17]	Scotland	55 y/o female	IHCA, witnessed VF	Rescuer reported	Internal heart massage	Pre-med induction	Died
Lewinter 1989[18]	USA	60 y/o female	IHCA, witnessed VF/ pVT	Rescuer reported	Mechanical	IV morphine and diazepam	Died
Quinn 1994[19]	Canada	57 y/o male	IHCA, witnessed PEA	Rescuer reported	Mechanical	Midazolam and succinylcholine	Died
McDonald 2005[20]	USA	Single case report mid-40 s male	IHCA, witnessed VF	Rescuer reported and patient recall	Manual	Not documented	Survived to discharge
Yu 2007[21]	Taiwan	Single case report 27 y/o female	IHCA, witnessed VT then asystole	Rescuer reported	Manual	Not documented	Survived to discharge
Bihari 2008[22]	USA	Single case report 57 y/o male	IHCA, witnessed asystole	Rescuer reported	Manual	Physical restraint	Died
Tobin 2009[23]	USA	Single case report 62 y/o male	IHCA, unwitnessed PEA	Rescuer reported	Manual	None	Died
Lapostolle 2012[24]	France	2 patient reports: 57 and 58 y/o both male	Not stated	Rescuer reported	Mechanical	Sedation used in one, not documented in the other	Died
Fauber 2011[25]	USA	Single case report 56 y/o male	OHCA, unwitnessed	Rescuer reported	Mechanical	Not documented	Survived to discharge
Ulrichs 2014[26]	Germany	Single case report 24 y/o female	IHCA,	Patient recall	Manual	Not documented	Survived to discharge
Greb 2014[27]	USA	Single case report 61 y/o male	OHCA, witnessed VF	Rescuer reported	Manual	Not documented	Survived to discharge
Gwinnutt 2015[28]	UK	Middle-aged female	IHCA, witnessed VF	Patient recall	Precordial thump	Not documented	Survival at a couple of days post arrest
Hoppenfeld 2016[29]	USA	2 patient reports: 50 and 51 y/o both male	Both IHCA, witnessed VF	Rescuer reported and patient recall	Manual	Not documented	Both survived post arrest phase
Oksar 2016[30]	Turkey	Single case report 69 y/o male	IHCA, witnessed VF then asystole	Rescuer reported	Manual	None	Extubated day 1
Pound 2016[31]	Canada	Single case report 52 y/o male	OHCA, unwitnessed VF	Rescuer reported	Manual	Midazolam 2 mg	Survived to discharge
Rice 2016[32]	USA	Single case report 55 y/o male	IHCA, VF	Rescuer reported and patient recall	Not documented	Ketamine 2 mg/kg	Survived to discharge
Grandi 2017[33]	Italy	6 case reports, aged 22–87 all male	Mixed aetiology	Rescuer reported	5 manual, 1 mechanical	Mix of physical restraint, fentanyl, propofol and	2 died, 4 survived to discharge

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Table 2 (continued)

Reference	Country	Demographics	Arrest type	Evidence of consciousness	CPR type	Sedation data	Survival data
						rocuronium	
Gray 2018[34]	Canada	Single case report 38 y/o male	IHCA, witnessed VF/ pVT	Rescuer reported and patient recall	Manual	4-point restraint	Survival to 3 months
Wacht 2015[35]	Israel	Single case report 57 y/o male	OHCA, witnessed VF	Rescuer reported	Manual then mechanical	Considered, not used	Survived to discharge
Pinto 2020[36]	Portugal	Single case report 89 y/o male	IHCA, witnessed VF and asystole	Rescuer reported	Manual	None	Died
Sukumar 2019[37]	India	Single case report 52 y/o male	In transit from primary to tertiary centre VF	Rescuer reported and patient recall	Manual	None	Survived to discharge
Asghar 2020[38]	Pakistan	Single case report 62 y/o male	IHCA, witnessed PEA	Rescuer reported	Manual	None	Died
Chin 2020[39]	Taiwan	Single case report 42 y/o male	OHCA, arrest witnessed VF	Rescuer reported	Manual	Not documented	Survived to discharge
Singh 2020[40]	USA	Single case report 64 y/o female	IHCA, unwitnessed VT	Rescuer reported	Manual	Not documented	Died
Czerwonka 2021[41]	Germany	Single case study 49 y/o male	OHCA, witnessed shockable rhythm	Rescuer reported (GCS documented as E4V2M5)	Manual	15 mg Midazolam, total of 0.6 mg fentanyl in 2 doses	Survived to discharge

Table 3 – Characteristics and results of review papers included in review.

Reference	Design	Question	Included studies	Outcomes extracted	Design type	Rescuer reports	CPR type	Sedation data	Survival data
Olaussen 2015[42]	Systematic review	Identify cases of CPR induced consciousness, and management strategies.	9 case studies, 10 patients IHCA $n = 3$ OHCA $n = 6$ Shockable rhythm $n = 5$ Non-shockable rhythm $n = 3$ Not reported = 1	Demographics Arrest factors CPR type and length consciousness description Sedation use Survival	Systematic review	Purposeful arm movements, eye opening, localising, verbal, and nonverbal communication, complying with instructions.	6 out of the 9 cases mechanical CPR	For 3 cases sedation status was not recorded, 1 no sedation, 2 physical restraint/ reassurance, 2 used sedation nonspecific, 1 small doses of morphine and diazepam, 1 midazolam and succinylcholine	4 out of 10 survived, 1 patient recalling events.
Lundsgaard 2019[1]	Shortcut review	In patients who show signs of awareness during CPR are analgesics and/or sedation indicated to improve patients' outcome?	3 case reports ($n = 8$), 1 letter to editor (no. not stated), 1 retrospective Cohort ($n = 117$ patients) 1 Prospective study (no. not stated), 1 systematic review ($n = 10$) Arrest types not reported in review	Key outcomes from selected study	Shortcut review	Limb movements, eye opening, finger gestures, localising	NA	Out of the 7 articles sedation outcome recorded in 5. 1 used midazolam + morphine a second midazolam only, 1 using ketamine, 1 propofol and fentanyl, 1 a combination of opioids, midazolam, and muscle relaxants	Not Recorded
Pourmand 2019[43]	Existing literature review	Literature search for unifying themes on CPR induced consciousness	1 retrospective study ($n = 112$) and 9 case studies ($n = 10$) total patients 122 OHCA $n = 115$ IHCA $n = 5$ Not recorded $n = 2$ Arrest rhythm not reported in review	Sedation compression device Total recall Neurological consequences	Existing literature review	Purposeful movements, communicating and eye opening	45% of retrospective study used mechanical CPR, 3 of the case studies mechanical, 5 manual	Sedation used in 3 out of the 9 case studies and in 49.5% of cases in the retrospective study. Mix of midazolam and ketamine used	3 out of 10 patients in the case studies deceased. 3 Case studies reported total recall

Table 4 – Summary of sedation regimens included in review.

Sedation protocol/guideline	Summary:
Rice Nebraska Protocol[32]	If Signs of consciousness give: Ketamine bolus IV 0.5–1.0 mg/Kg, IM 2–3 mg/Kg Consider Midazolam bolus 1 mg IV, 2 mg IM Can repeat ketamine bolus every 5–10 min or infusion 2-7mcg/Kg/min
Dutch Ambulance service guidelines[44]	When giving mechanical chest compressions: Fentanyl 2mcg/Kg or Midazolam 2.5 mg
Wellington Free Ambulance service guidelines[45]	If movement significant enough to interfere with resuscitation: Ketamine IV 1 mg/Kg If continuing significant movement rocuronium (if ETT in place)
Ambulance Victoria guidelines[46]	If patient interferes with CPR, has present gag reflex, or appears to be aware: Fentanyl 25mcg IV, repeat every 3–5 min If critical care trained Ketamine 20 mg IV/IO, repeat every 3–5 min

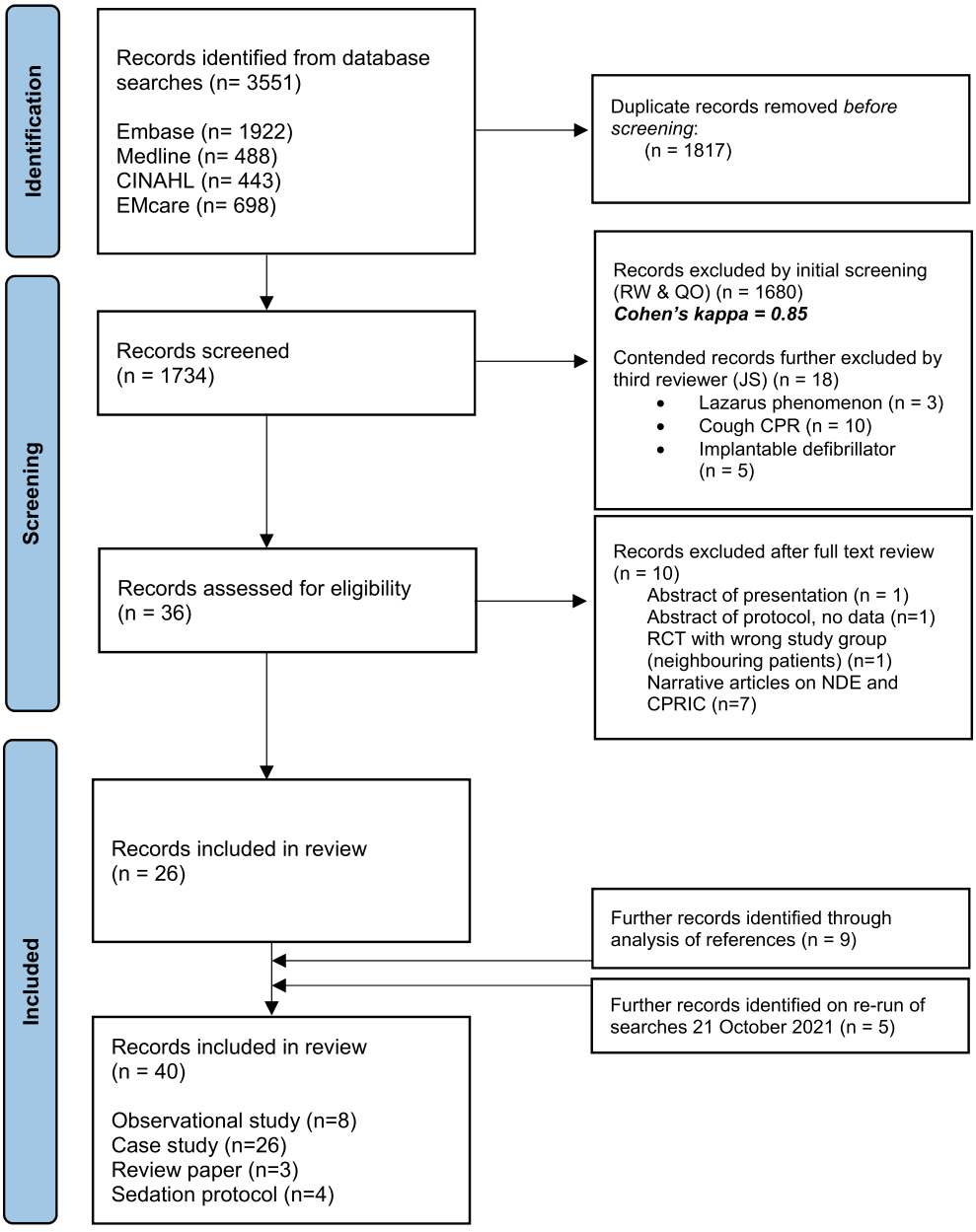

Fig. 1 – PRISMA flow diagram.

the patient resisting having chest compressions or trying to pull out vascular access devices, the need to pause CPR and reassure the patient, and the need to use sedative or paralysing drugs and physical restraint.[13–15]

CPR-induced consciousness was mainly reported in patients with VF/pVT arrests witnessed by a healthcare professional in observational studies (Table 1) and case reports (Table 2). CPR-induced consciousness was associated with increased ROSC, survival to hospital admission and survival to discharge.[10,12] In one observational study, after risk adjustment for arrest factors, CPR-induced consciousness was associated with increased odds of survival to hospital discharge in unwitnessed/bystander witnessed arrests but not EMS witnessed arrests[10] A single observational study reported that 27% of cardiac arrest survivors who had CPR-induced consciousness went on to develop PTSD.[8]

In an international multicentre observational study 55 (39%) of 140 cardiac arrest survivors reported having perceived a sense of awareness from the time of being unconscious, but without any explicit recall of resuscitation related events or other cognitive memories.[9] 32 of a subgroup of 101 survivors had cognitive recollections that comprised multiple themes, including fear. 9 survivors recalled memories that were consistent with near-death experiences and 2 described awareness with explicit recall of seeing and hearing events during CPR. In this study, there was no objective evidence of signs of consciousness such as agitation, eye opening, or localising by patients who were able to perceive memories/recall of the resuscitation. This suggests that awareness may be present without overt signs of consciousness.

Two case reports describe CPR-induced consciousness causing rescuer distress and unease for a considerable time after the event.[20,38] In an observational study of physicians who had reported CPR-induced consciousness, over 90% reported it having a detrimental effect on them with 52% reporting personal discomfort and 7% reporting sleeplessness, nightmares and mood change.[14]

Patient sedation or analgesia was rarely reported in the management of CPR-induced consciousness ranging from 12% to 39% in the included observational studies (Table 1) and 26% of the case reports (Table 2). Two studies commented on the effects of sedation and analgesia on patients. One study observed that boluses or infusion of sedation or analgesic drugs during resuscitation was not associated with a decrease in PTSD in survivors.[8] Another study observed that sedation or analgesia use was associated with a worse outcome including an increase in termination of resuscitation at the scene, increased time to ROSC, and decreased survival to hospital admission.[42] When sedation was used there was a variety of drugs used, ranging from midazolam and ketamine to rocuronium and diazepam (Tables 1–3). We identified 4 local policy guidelines found (Table 4) with ketamine, midazolam and fentanyl alone or in combination being the most commonly used drugs.

Discussion

The concept of CPR related cognitive activity, consciousness, awareness, and recall is complex. Our scoping review found both visible signs of consciousness (such as combativeness, groaning and eye opening); and the perception of lucidity, visual/auditory awareness, and near-death experiences (with or without recall). Interestingly, patients with awareness or recall of events do not always present with visible signs of consciousness.

Instances of CPR-induced consciousness appear to be more common in professional rescuer witnessed sudden cardiac arrests caused by shockable rhythms with presumed cardiac aetiology, possibly giving us a starting point to try and predict the patients who are at greater risk of CPR-induced consciousness.[10,12] There is also evidence that CPR-induced consciousness causes a degree of distress to rescuers, including sleeplessness and mood changes,[14] with mixed evidence regarding patient outcomes. Witnessed cardiac arrests with an initial shockable rhythm and early CPR and defibrillation have the best chance of survival and CPR-induced consciousness may suggest favourable cerebral perfusion during CPR.

There are multiple narrative articles exploring the theory of physical entity, the mind, consciousness and how these are interlinked and related to CPR-induced consciousness and instances of awareness or recall after CPR.[47,48] A recurring feature reported is a paradoxical perception of separated external visual and auditory awareness, which has at times been referred to using the ill-defined and ill-understood phenomenon of "out of body experiences". Unlike overt signs of consciousness, such as movement, obeying commands and speaking as mentioned in several of the studies, patient awareness and recall is much more difficult to define. The term near death experience has previously been used to describe the range of memories, thoughts, feelings and auras that patients experienced post cardiac arrest, and attempts have been made to categorise and study these through the Near-Death Experience Scale developed by Greyson.[2] Parnia has identified multiple cognitive themes, including fear, that do not fit into the classical near-death experience definition, suggesting that this term may not encompass the entire patient experience.[9,11] Furthermore, in one study 2 patients reported a sense of separated external visual and auditory awareness and in one case, the accuracy of the perceived recollections by the patient was able to be confirmed. Whilst we have limited understanding on the processes behind this phenomenon, we have even less understanding on the long-term implications for both patient and rescuer. It is well known that sufferers of cardiac arrest are at risk of PTSD.[8] It could be assumed that pain and distress would be expected in patients showing overt physical signs of consciousness through CPR. On the other hand, there have also been cases documented where survivors experiencing more transcendental post cardiac arrest experiences whilst not showing signs of pain or distress have benefited from the experience with it having a positive impact on the patient's life.[11] When considering treatment options, it may be beneficial to consider these two experiences as two separate entities. Further difficulty remains with survivors being able to distinguish awareness and recall during cardiac arrest and CPR from experiences during ICU care and emergence from coma. Clinicians may struggle to quantify and define these patient experiences, and this may lead to difficulty in recording, validating and addressing them, including providing appropriate mental health support.

Our scoping review suggests there is limited evidence to best inform whether management of CPR-induced consciousness or the long-term psychological impact of awareness and recall in survivors is necessary, and if it is what the optimal strategy is.

One review article has suggested that if medication was being used, the ideal drug should have a fast smooth onset of action, be rapidly destroyed in the bloodstream without redistribution, not cause cardiorespiratory depression, not increase cerebral blood flow or intracranial pressure and it should increase the seizure threshold.[49] The ideal available drug is not clear and ketamine and midazolam use appears most common in reported protocols.

The ILCOR ALS Task Force consensus on cardiopulmonary resuscitation and Emergency cardiovascular care science with treatment recommendations (2021) includes a summary of this review with good practice statements.[50]

Limitations

As only a scoping review was conducted, we did not critically appraise each study for its strengths, weaknesses and biases, nor did we assess the certainty of evidence overall or attempt to make treatment recommendations. There are still gaps in our knowledge and more research in these areas is needed.

We did not specifically investigate phenomena surrounding CPR-induced consciousness such as the Lazarus phenomenon, cough-assisted CPR and consciousness during cardiac arrest with a ventricular assist device in situ. Nor did we look in depth into near-death experiences, their prevalence or the pathophysiology potentially causing these experiences.

Conclusion

CPR-related cognitive activity, consciousness, awareness and recall is uncommon but increasingly reported by professional rescuers. The data available was heterogeneous in nature and not suitable for progression to a systematic review process. Although local treatment protocols exist for management of CPR-induced consciousness, there are no widely accepted treatment guidelines. In settings in which it is feasible, rescuers may consider using sedative or analgesic drugs doses to prevent pain and distress to patients who are conscious during CPR. More studies are required to investigate the management of CPR-induced consciousness.

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Declaration of interests

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CRediT authorship contribution statement

Rebecca L. West: Methodology, Writing – review and editing. **Quentin Otto:** Methodology, Writing – review & editing. **Ian R. Drennan:** Methodology, Writing – review & editing. **Sarah Rudd:** Methodology. **Bernd W. Böttiger:** Writing – review & editing. **Sam Parnia:** Writing – review & editing. **Jasmeet Soar:** Supervision, Conceptualization, Methodology, Writing – review & editing.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2022.100241.

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