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

Rebecca L. West a, Quentin Otto a, Ian R. Drennan b, c, Sarah Rudd a, Bernd W. Böttiger d, Sam Parnia e, Jasmeet Soar a,

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
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. It was drafted using the preferred reporting items for systematic reviews and Meta-analysis protocols extension for Scoping Reviews (PRISMA-ScR).

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 and cough CPR 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 combative-ness, 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.

Observational studies estimated that CPR-induced consciousness occurred in 0.23% to 0.9% of all CPR attempts with combative-ness or agitation reported in 34.6% cases as the most common sign. 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
| 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 | 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. |
| Parnia 2014 | 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 NA 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 |
| Olaussen 2017 | 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 0.9% in 2014) | Higher proportion of CPR-induced consciousness patients had: Witnessed arrests CPR-induced consciousness in unwitnessed/bystander witnessed events 37.5% received treatment: 1 or more of midazolam, opioids, or muscle relaxants. When stratified by use of these medications, CPR-induced consciousness was independently associated with an increased odds of survival to hospital discharge in unwitnessed/bystander witnessed events. | 37.5% received treatment: 1 or more of midazolam, opioids, or muscle relaxants. When stratified by use of these medications, CPR-induced consciousness was independently associated with an increased odds of survival to hospital discharge in unwitnessed/bystander witnessed events. | (continued on next page) |
| Reference       | Study Design     | Setting                              | Population                        | Outcomes Measured                  | Prevalence of CPR related observations | Characteristics of CPR related observations | Sedation data | Survival data |
|-----------------|------------------|--------------------------------------|-----------------------------------|------------------------------------|----------------------------------------|---------------------------------------------|---------------|---------------|
| **Parnia 2019** | 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**   | 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 CPR-induced consciousness rate of 2.3 per 1000 over a year period. | Sedation used | Higher proportion of CPR-induced consciousness cases happened in public locations, with initial shockable 12-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, 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 |
| Reference | Study Design | Setting | Population | Outcomes Measured | Prevalence of CPR related observations | Characteristics of CPR related observations | Sedation data | Survival data |
|-----------|--------------|---------|------------|-------------------|---------------------------------------|-------------------------------------------|---------------|--------------|
| **Rescuer studies** | | | | | | | | |
| Olausen 2016 | 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 | 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. | NA | 45% used midazolam, 11% used ketamine, 4% opioids All worried medication may have negative impact circulation and felt there was a lack of evidence on dose-effects relationship. |
| Gregory 2020 | 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 |

(continued on next page)
| Reference | Study Design | Setting | Population | Outcomes Measured | Prevalence of CPR related observations | Characteristics of CPR related observations | Sedation data | Survival data |
|-----------|--------------|---------|------------|-------------------|----------------------------------------|---------------------------------------------|---------------|--------------|
|           |              |         |            |                   | consciousness, of whom 56% reported multiple cases. | interference with CPR. | 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.
| Reference | Country | Demographics | Arrest type | Evidence of consciousness | CPR type | Sedation data | Survival data |
|-----------|---------|--------------|-------------|-----------------------------|----------|---------------|---------------|
| Bernier 1962 | USA | 63 y/o male | IHCA, VF | Rescuer reported | Manual | None | Survival at 1 year |
| Miller 1961 | Scotland | 55 y/o female | IHCA, witnessed VF | Rescuer reported | Internal heart massage | Pre-med induction | Died |
| Lewinter 1989 | USA | 60 y/o female | IHCA, witnessed VF/PVT | Rescuer reported | Mechanical | IV morphine and diazepam | Died |
| Quinn 1994 | Canada | 57 y/o male | IHCA, witnessed PEA | Rescuer reported | Mechanical | Midazolam and succinylcholine | Died |
| McDonald 2005 | USA | Single case report mid-40 s male | IHCA, witnessed VF | Rescuer reported and patient recall | Manual | Not documented | Survived to discharge |
| Yu 2007 | Taiwan | Single case report 27 y/o female | IHCA, witnessed VT then asystole | Rescuer reported | Manual | Not documented | Survived to discharge |
| Bihari 2008 | USA | Single case report 57 y/o male | IHCA, witnessed asystole | Rescuer reported | Manual | Physical restraint | Died |
| Tobin 2009 | USA | Single case report 62 y/o male | IHCA, unwitnessed PEA | Rescuer reported | Manual | None | Died |
| Lapostolle 2012 | 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 | USA | Single case report 56 y/o male | OHCA, unwitnessed | Rescuer reported | Mechanical | Not documented | Survived to discharge |
| Ulrichs 2014 | Germany | Single case report 24 y/o female | IHCA, | Patient recall | Manual | Not documented | Survived to discharge |
| Greb 2014 | USA | Single case report 61 y/o male | OHCA, witnessed VF | Rescuer reported | Manual | Not documented | Survived to discharge |
| Gwinnutt 2015 | UK | Middle-aged female | IHCA, witnessed VF | Patient recall | Precordial thump | Not documented | Survival at a couple of days post arrest |
| Hoppenfeld 2016 | USA | 2 patient reports: 50 Both IHCA, and 51 y/o both male witnessed VF | Rescuer reported and patient recall | Manual | Not documented | Both survived post arrest phase |
| Oksar 2016 | Turkey | Single case report 69 y/o male | IHCA, witnessedVF then asystole | Rescuer reported | Manual | None | Extubated day 1 |
| Pound 2016 | Canada | Single case report 52 y/o male | OHCA, unwitnessed VF | Rescuer reported | Manual | Midazolam 2 mg | Survived to discharge |
| Rice 2016 | 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 | Italy | 6 case reports, agedMixed aetiology | Rescuer reported | 5 manual, 1 mechanical | Mix of physical restraint, fentanyl, propofol and ketamine | 2 died, 4 survived to discharge | (continued on next page) |
| Reference    | Country     | Demographics                  | Arrest type               | Evidence of consciousness | CPR type         | Sedation data                           | Survival data         |
|--------------|-------------|-------------------------------|---------------------------|---------------------------|------------------|-----------------------------------------|-----------------------|
| Gray 2018    | Canada      | Single case report 38 y/o male| IHCA, witnessed VF/pVT    | Rescuer reported and patient recall | Manual           | rocuronium                              | Survival to 3 months  |
| Wacht 2015   | Israel      | Single case report 57 y/o male| OHCA, witnessed VF        | Rescuer reported          | Manual then mechanical | Considered, not used                     | Survived to discharge |
| Pinto 2020   | Portugal    | Single case report 89 y/o male| IHCA, witnessed VF and asystole | Rescuer reported         | Manual           | None                                     | Died                  |
| Sukumar 2019 | 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  | Pakistan    | Single case report 62 y/o male| IHCA, witnessed PEA       | Rescuer reported          | Manual           | None                                     | Died                  |
| Chin 2020    | Taiwan      | Single case report 42 y/o male| OHCA, arrest witnessed VF | Rescuer reported          | Manual           | Not documented                           | Survived to discharge |
| Singh 2020   | USA         | Single case report 64 y/o female| IHCA, unwitnessed VT      | Rescuer reported          | Manual           | Not documented                           | Died                  |
| Czerwonka 2021 | Germany    | Single case study y/o male    | 49OHCA, 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  |
| Reference | Design | Question | Included studies | Outcomes extracted | Design type | Rescuer reports | CPR type | Sedation data | Survival data |
|-----------|--------|----------|-----------------|-------------------|-------------|----------------|----------|--------------|--------------|
| Olaussen 2015<sup>15</sup> | Systematic review | Identify cases of CPR induced consciousness, and management strategies. | 9 case studies, 10 patients | Demographics, Arrest factors CPR type and length consciousness description | Systematic review | Purposeful arm movements, eye opening, localising, verbal, and nonverbal communication, complying with instructions. | 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 cases mechanical CPR | 6 out of the 9 cases | 4 out of 10 survived, 1 patient recalling events. |
| Lundsgaard 2019<sup>1</sup> | 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) | Limb movements, NA eye opening, finger gestures, localising | Shortcut review | 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<sup>13</sup> | 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 | 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                         | If Signs of consciousness give: Ketamine bolus IV 0.5–1.0 mg/Kg, IM 2–3 mg/Kg<br>Consider Midazolam bolus 1 mg IV, 2 mg IM<br>Can repeat ketamine bolus every 5–10 min or infusion 2–7 mcg/Kg/min |
| Dutch Ambulance service guidelines             | When giving mechanical chest compressions: Fentanyl 2 mcg/Kg or Midazolam 2.5 mg                                                       |
| Wellington Free Ambulance service guidelines   | If movement significant enough to interfere with resuscitation: Ketamine IV 1 mg/Kg<br>If continuing significant movement rocuronium (if ETT in place) |
| Ambulance Victoria guidelines                  | If patient interferes with CPR, has present gag reflex, or appears to be aware: Fentanyl 25 mcg IV, repeat every 3–5 min<br>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.12 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.6 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.32 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.

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.5 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 transcendent 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.

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.
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.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of interests

RLW, QO, IRD, SR, BWB declare no conflicts of interest. SP has received grants in the past for studies of awareness during CPR. JS is an Editor of Resuscitation and received payment from the publisher Elsevier.

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.

Acknowledgements

The authors are grateful to the ILCOR ALS Task Force for assisting in the development of this Scoping Review: Lars W. Andersen, Katherine M. Berg, Clifton W. Callaway, Keith Couper, Charles D. Deakin, Karen Hirsch, Matthias J. Holmberg, Cindy H. Hsu, Eric J. Lavonas, Peter Morley, Laurie J. Morrison, Kevin Nation, Tonia C. Nicholson, Nikolaos Nikolau, Jerry P. Nolan, Brian J. O’Neil, Robert W. Neumar, Edison F. Paiva, Michael J. Parr, Joshua C. Reynolds, Claudio Sandroni, Markus B. Skrifvars, Tzong-Luen Wang, Michelle Welsford.

Appendix A. Supplementary material

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

Author details

1Anaesthetics Department, Southmead Hospital, North Bristol NHS Trust, Bristol, UK 2Sunnybrook Centre for Prehospital Medicine, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada 3Division of Emergency Medicine, Department of Family and Community Medicine, University of Toronto, Toronto, Ontario, Canada 4Department of Anaesthesiology and Intensive Care Medicine, University Hospital of Cologne, Cologne, Germany 5Division of Pulmonary, Critical Care and Sleep Medicine, New York University Langone Medical Center, New York City, USA

REFERENCES

1. Lundsgaard RS, Lundsgaard KS. BET 2: Pain management in patients who show awareness during CPR. Emerg Med J 2019;36:249–50.
2. Greysen B. The near-death experience scale. Construction, reliability, and validity. J Nerv Ment Dis 1983;171:369–75.
3. West RL, Otto Q, Parnia S, Soar J. A proposed classification for CPR-related cognitive activity, consciousness, awareness and recall. Resuscitation 2021;165:83–4.
4. Morley PT et al. Evidence Evaluation Process and Management of Potential Conflicts of Interest: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation 2020;156:A23–34.
5. Tricco AC et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 2018;169:467.
6. Gordon L, Pasquier M, Brugger H, Paal P. Autoresuscitation (Lazarus phenomenon) after termination of cardiopulmonary resuscitation - a scoping review. Scand J Trauma Resusc Emerg Med 2020;28:14.
7. Dee R et al. The effect of alternative methods of cardiopulmonary resuscitation - Cough CPR, percussion pacing or precordial thump - on outcomes following cardiac arrest. A systematic review. Resuscitation 2021;162:73–81.
8. Gamper G et al. Life after death: posttraumatic stress disorder in survivors of cardiac arrest–prevalence, associated factors, and the influence of sedation and analgesia. Crit Care Med 2004;32:378–83.
9. Parnia S et al. AWARE-AWAreness during REsuscitation-A prospective study. Resuscitation 2014;85:1799–805.
10. Olaussen A et al. Consciousness induced during cardiopulmonary resuscitation: An observational study. Resuscitation 2017;N.PAG.N.
11. Parnia S, Keshavarz T, McMullin M, Williams T. Abstract 387: Awareness and Cognitive Activity During Cardiac Arrest. Circulation 2019;140:A387.
12. Doan TN et al. Insights into the epidemiology of cardiopulmonary resuscitation-induced consciousness in out-of-hospital cardiac arrest. Emerg Med Austral 2020;32:769–76.
13. Olaussen A et al. CPR-induced consciousness: A cross-sectional study of healthcare practitioners’ experience. Austr Emerg Nurs J: AENJ 2016;19:186–90.
14. Versteeg J, Noordergraaf J, Vis L, Willems P, Bremer R. CPR-induced consciousness: attention required for caregivers and medication. Resuscitation 2019;142:e35.
15. Gregory P, Mays B, Kilter T, Sudron C. An exploration of UK Paramedics’ experiences of Cardiopulmonary resuscitation induced consciousness. Br Paramed J 2020.
16. Bernier GM. Maintenance of consciousness during closed-chest massage. JAMA 1962;181:446–7.
17. Miller JB, Davie RD, Douglas DM. The efficiency of cardiac massage in ventricular fibrillation. Description of an instance of recovery of consciousness without spontaneous heart beat. Br J Anaesth 1961;33:22–3.
18. Lewinter JR, Carden DL, Nowak RM, Enriquez E, Martin GB. CPR-dependent consciousness: evidence for cardiac compression causing forward flow. Ann Emerg Med 1989;18:1111–5.
19. Quinn JV, Hebert PC, Stell IG. Need for sedation in a patient undergoing active compression–decompression cardiopulmonary resuscitation. Acad Emerg Med 1994;1:463–6. discussion 466–467.
20. McDonald GP. Code blue stories. Awake and aware in the emergency department. Hosp Phys 2005;41:12.
21. Yu HY et al. Ultra long cardiopulmonary resuscitation with intact cerebral performance for an asystolic patient with acute myocarditis. Resuscitation 2007;73:307–8.
22. Bihari S, Rajajee V. Prolonged retention of awareness during cardiopulmonary resuscitation for asystolic cardiac arrest. Neurocritical Care 2008;9:382–6.
23. Tobin JM, Mihm FG. A hemodynamic profile for consciousness during cardiopulmonary resuscitation. Anesth Analgesia 2009;109:1598–9.
24. Lapostolle F, Petrovic T, Alhéritière A, Agostinucci J-M, Adnet F. Life signs in ‘dead’ patients. Resuscitation 2012;83:e164.
25. Fauber J. New CPR devices save lives, Medical College study finds. 2011. https://archive.jsonline.com/news/health/114171424.html/.
26. Ulrichs CJ, Bottiger BW, Padosch SA. Total recall–is it ethical to not to sedate people during successful resuscitation? Resuscitation 2014;85:e49.
27. Greb C, Heightman AJ. Mechanical CPR Helps Save the Day—and the Patient. JEMS 2014. Available from: https://www.jems.com/patient-care/mechanical-cpr-helps-save-day-and-patient/.
28. Gwinnutt C. Awareness during resuscitation. Resuscitation 2015;97: e17.
29. Hopenfeld MS, Kotov A, Ortega R. Ventricular fibrillation and consciousness are not mutually exclusive. Resuscitation 2016;100: e1–2.
30. Oksar M, Turhanoglu S. Is It Possible to Maintain Consciousness and Spontaneous Ventilation with Chest Compression in the Early Phase of Cardiac Arrest? Case Rep Anesthesiol 2016;2016:3158015.
31. Pound J, Verbeek PR, Cheskes S. CPR Induced Consciousness During Out-Of-Hospital Cardiac Arrest: A Case Report on an Emerging Phenomenon. Prehospital Emerg Care 2016;1–5. https://doi.org/10.1080/10903127.2016.1229823.
32. Rice DT, Nuddell NG, Habrat DA, Smith JE, Ernest EV. CPR induced consciousness: It’s time for sedation protocols for this growing population. Resuscitation 2016;103:e15–6.
33. Grandi T et al. Six Cases Of CPR-Induced Consciousness In Witnessed Cardiac Arrest. Italian J Emerg Med SIMEU 2017. Available from: https://www.itjem.org/2017/03/01/six-cases-of-cpr-induced-consciousness-in-witnessed-cardiac-arrest/.
34. Gray R. Consciousness with cardiopulmonary resuscitation. Can Fam Phys 2018;64:514–7.
35. Wacht O, Huri R, Strugo R. CASE STUDY: COMBATIVE CARDIAC PATIENT. What do you do when a patient regains consciousness during mechanical CPR? EMS World 2015;44:29–33.
36. Pinto J, Almeida P, Ribeiro F, Simoes R. Cardiopulmonary resuscitation induced consciousness a case report in an Elderly Patient. Eur J Case Rep Internal Med 2020;.
37. Sukumar V. Having a Conscious Patient During Cardiopulmonary Resuscitation: Is It Not Time to Consider Sedation Protocol?: A Case Report. A&A Pract 2019;13:250–2.
38. Asghar A, Salim B, Tahir S, Islam F, Khan MF. Awareness during cardiopulmonary resuscitation. Indian J Crit Care Med 2020;24:136–7.
39. Chin KC, Yang SC, Chiang WC. Video of cardiopulmonary resuscitation induced consciousness during ventricular fibrillation. Resuscitation 2020;155:22–3.
40. Singh RP, Adhikari S, Landsberg D, Kaul V. Cardiopulmonary resuscitation–induced consciousness. Baylor Univ Med Center Proc 2021;34:187–8.
41. Czerwonka H, Sroka M. Eine nicht ganz normale “Reanimation bei Kammerflimmern – Wachheit während der Wiederbelebung. Der Notarzt 2021;37:25–9.
42. Olaussen A et al. Return of consciousness during ongoing cardiopulmonary resuscitation: A systematic review. Resuscitation 2015;86:44–8.
43. Pourmand A, Hill B, Yamane D, Kuhl E. Approach to cardiopulmonary resuscitation induced consciousness, an emergency medicine perspective. Am J Emerg Med 2019;37:751–6.
44. Ambulancezorg Nederland. Landelijk Protocol Ambulancezorg, Version 8.1, Chapter 5.2. (2016).
45. Wellington Free Ambulance. Clinical Procedures and Guidelines 2019-22. (2019).
46. Ambulance Victoria. Clinical Practice Guidelines ALS and MICA Paramedics Version 4.0.0. (2019).
47. Parnia S. Do reports of consciousness during cardiac arrest hold the key to discovering the nature of consciousness? Med Hypotheses 2007;69:933–7.
48. Parnia S, Fenwick P. Near death experiences in cardiac arrest: Visions of a dying brain or visions of a new science of consciousness. Resuscitation 2002;52:5–11.
49. Martens P, Mullie A. Sedation during and after CPR-efforts: is it worth a guideline? Resuscitation 1995;29:223–4.
50. Wyckoff MH et al. 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Neonatal Life Support; Education, Implementation, and Teams; First Aid Task Forces; and the COVID-19 Working Group. Resuscitation 2021;169;229–311.