**Table 1. Observational Studies:**

CPRIC = CPR induced consciousness, NDE = near death experience

**REFERENCES**

1. Gamper G, Willeit M, Sterz F, Herkner H, Zoufaly A, Hornik K, Havel C, Laggner AN. 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 Feb;32(2):378-83. doi: 10.1097/01.CCM.0000108880.97967.C0. PMID: 14758151.
2. Parnia S, Spearpoint K, de Vos G, Fenwick P, Goldberg D, Yang J, Zhu J, Baker K, Killingback H, McLean P, Wood M, Zafari AM, Dickert N, Beisteiner R, Sterz F, Berger M, Warlow C, Bullock S, Lovett S, McPara RM, Marti-Navarette S, Cushing P, Wills P, Harris K, Sutton J, Walmsley A, Deakin CD, Little P, Farber M, Greyson B, Schoenfeld ER. AWARE-AWAreness during REsuscitation-a prospective study. Resuscitation. 2014 Dec;85(12):1799-805. doi: 10.1016/j.resuscitation.2014.09.004. Epub 2014 Oct 7. PMID: 25301715.
3. Olaussen A, Shepherd M, Nehme Z, Smith K, Jennings PA, Bernard S, Mitra B. CPR-induced consciousness: A cross-sectional study of healthcare practitioners' experience. Australas Emerg Nurs J. 2016 Nov;19(4):186-190. doi: 10.1016/j.aenj.2016.07.002. Epub 2016 Jul 29. PMID: 27478148.
4. Olaussen A, Nehme Z, Shepherd M, Jennings PA, Bernard S, Mitra B, Smith K. Consciousness induced during cardiopulmonary resuscitation: An observational study. Resuscitation. 2017 Apr;113:44-50. doi: 10.1016/j.resuscitation.2017.01.018. Epub 2017 Feb 1. PMID: 28161214.
5. Doan TN, Adams L, Schultz BV, Bunting D, Parker L, Rashford S, Bosley E. Insights into the epidemiology of cardiopulmonary resuscitation-induced consciousness in out-of-hospital cardiac arrest. Emerg Med Australas. 2020 Oct;32(5):769-776. doi: 10.1111/1742-6723.13505. Epub 2020 Mar 26. PMID: 32220008.

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| --- | --- | --- | --- | --- |
| **Reference** | **Evidence of consciousness** | **CPR type** | **Sedation** | **Survival** |
| 1. Bernier 19628 | Rescuer reported | Manual | None | Survival at 1 year |
| 1. Miller 19629 | Rescuer reported | Internal heart massage | Pre-med induction | Died |
| 1. Lewinter 1988 | Rescuer reported | Mechanical | IV morphine and diazepam | Died |
| 1. Quinn 1993 | Rescuer reported | Mechanical | Midazolam and succinylcholine | Died |
| 1. Mcdonald 2005 | Both rescuer reported and recall | Manual | not documented | survived to discharge |
| 1. Yu 2006 | Rescuer reported | Manual | not documented | survived to discharge |
| 1. Bihari 2008 | Rescuer reported | Manual | Physical restraint | Died |
| 1. Tobin 2009 | Rescuer reported | Manual | None | Died |
| 1. Frederic 2011 | Rescuer reported | Mechanical | Sedation used in one, not documented in the other | Died |
| 1. Fauber 2011 | Rescuer reported | Mechanical | not documented | survived to discharge |
| 1. Ulrichs 2014 | Patient recall | Manual | not documented | survived to discharge |
| 1. Greb and Heightman 2014 | Rescuer reported | Manual | not documented | survived to discharge |
| 1. Gwinnutt 2015 | Patient recall | Precordial thump | not documented | Survival at a couple of days post arrest |
| 1. Hoppenfeld 2015 | Both rescuer reported and recall | Manual | not documented | Both survived post arrest phase |
| 1. Oksar 2016 | Rescuer reported | Manual | None | Extubated day 1 |
| 1. Pound 2016 | Rescuer reported | Manual | Midazolam 2mg | survived to discharge |
| 1. Rice 2016 | Both rescuer reported and recall | Not documented | Ketamine 2mg/kg | survived to discharge |
| 1. Grandi 2017 | Rescuer reported | 5 manual, 1 mechanical | Mix of physical restraint, fentanyl, propofol and rocuronium | 2 died, 4 survived to discharge |
| 1. Gray 2018 | Both rescuer reported and recall | Manual | 4-point restraint | Survival to 3 months |
| 1. Wacht 2018 | Rescuer reported | Manual then mechanical | Considered, not used | survived to discharge |
| 1. Pinto 2019 | Rescuer reported | Manual | None | Died |
| 1. Sukumar 2019 | Both rescuer reported and recall | Manual | None | survived to discharge |
| 1. Ashgar 2020 | Rescuer reported | Manual | None | Died |
| 1. Chin 2020 | Rescuer reported | Manual | not documented | survived to discharge |

**Table 2. Case Studies:**

REFERENCES

1. BERNIER GM. Maintenance of consciousness during closed-chest massage. JAMA. 1962 Aug 4;181:446-7. doi: 10.1001/jama.1962.03050310086018c. PMID: 13868195.
2. 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 Jan;33:22-3. doi: 10.1093/bja/33.1.22. PMID: 13770803.
3. Lewinter JR, Carden DL, Nowak RM, Enriquez E, Martin GB. CPR-dependent consciousness: evidence for cardiac compression causing forward flow. Ann Emerg Med. 1989 Oct;18(10):1111-5. doi: 10.1016/s0196-0644(89)80942-4. PMID: 2802288.
4. Quinn JV, Hebert PC, Stiell IG. Need for sedation in a patient undergoing active compression--decompression cardiopulmonary resuscitation. Acad Emerg Med. 1994 Sep-Oct;1(5):463-6, discussion 466-7. doi: 10.1111/j.1553-2712.1994.tb02529.x. PMID: 7614304.
5. . McDonald GP. Code blue stories. Awake and aware in the emergency department. Hosp Physician. 2005;41:12
6. Yu HY, Yeh HL, Wang SS, Tsai MK, Chen YS, Ko WJ, Lin FY. Ultra long cardiopulmonary resuscitation with intact cerebral performance for an asystolic patient with acute myocarditis. Resuscitation. 2007 May;73(2):307-8. doi: 10.1016/j.resuscitation.2006.08.012. Epub 2007 Jan 17. PMID: 17234321.
7. Bihari S, Rajajee V. Prolonged retention of awareness during cardiopulmonary resuscitation for asystolic cardiac arrest. Neurocrit Care. 2008;9(3):382-6. doi: 10.1007/s12028-008-9099-2. PMID: 18483881.
8. Tobin JM, Mihm FG. A hemodynamic profile for consciousness during cardiopulmonary resuscitation. Anesth Analg. 2009 Nov;109(5):1598-9. doi: 10.1213/ANE.0b013e3181b89432. PMID: 19843796.
9. Lapostolle F, Petrovic T, Alhéritière A, Agostinucci JM, Adnet F. Life signs in "dead" patients. Resuscitation. 2012 Jul;83(7):e164. doi: 10.1016/j.resuscitation.2012.01.045. Epub 2012 Mar 23. PMID: 22450657.
10. Fauber J. New CPR devices save lives, medical college study finds. J Sentin 2011. <http://www.jsonline.com/news/health/114171424.html> [Accessed 02/01/2021]
11. Ulrichs CJ, Böttiger BW, Padosch SA. Total recall--is it ethical not to sedate people during successful resuscitation? Resuscitation. 2014 Apr;85(4):e49. doi: 10.1016/j.resuscitation.2013.12.026. Epub 2014 Jan 8. PMID: 24412762.
12. Greb C., NREMT-P , A.J. Heightman, MPA, EMT-P Mechanical CPR Helps Save the Day–and the Patient 1.29.2014 <https://www.jems.com/patient-care/mechanical-cpr-helps-save-day-and-patien/> [Accessed 05/01/2021]
13. Gwinnutt C. Awareness during resuscitation. Resuscitation. 2015 Dec;97:e17. doi: 10.1016/j.resuscitation.2014.12.036. Epub 2015 Oct 9. PMID: 26455397.
14. Hoppenfeld MS, Kotov A, Ortega R. Ventricular fibrillation and consciousness are not mutually exclusive. Resuscitation. 2016 Mar;100:e1-2. doi: 10.1016/j.resuscitation.2015.11.025. Epub 2015 Dec 18. PMID: 26708449.
15. 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. doi: 10.1155/2016/3158015. Epub 2016 Feb 11. PMID: 26981288; PMCID: PMC4766314.
16. Pound J, Verbeek PR, Cheskes S. CPR Induced Consciousness During Out-of-Hospital Cardiac Arrest: A Case Report on an Emerging Phenomenon. Prehosp Emerg Care. 2017 Mar-Apr;21(2):252-256. doi: 10.1080/10903127.2016.1229823. Epub 2016 Oct 28. PMID: 27791428.
17. Rice DT, Nudell NG, Habrat DA, Smith JE, Ernest EV. CPR induced consciousness: It's time for sedation protocols for this growing population. Resuscitation. 2016 Jun;103:e15-e16. doi: 10.1016/j.resuscitation.2016.02.013. Epub 2016 Mar 5. PMID: 26956842.
18. Grandi T, DE Carlo S, Carosi V, Visentin A, Fanton N, Baldo D, Paganini M. IX CASES OF CPR-INDUCED CONSCIOUSNESS IN WITNESSED CARDIAC ARREST Italian Journal of Emergency Medicine 01/2017 <https://www.itjem.org/2017/03/01/six-cases-of-cpr-induced-consciousness-in-witnessed-cardiac-arrest/> [accessed 10/01/2021]
19. Gray R. Consciousness with cardiopulmonary resuscitation. Can Fam Physician. 2018 Jul;64(7):514-517. PMID: 30002027; PMCID: PMC6042660.
20. 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 Aug;44(8):29-33. PMID: 26357830.
21. Pinto J, Almeida P, Ribeiro F, Simões R. Cardiopulmonary Resuscitation Induced Consciousness A Case Report in an Elderly Patient. Eur J Case Rep Intern Med. 2020 Jan 13;7(2):001409. doi: 10.12890/2020\_001409. PMID: 32133313; PMCID: PMC7050970.
22. Sukumar V. Having a Conscious Patient During Cardiopulmonary Resuscitation: Is It Not Time to Consider Sedation Protocol?: A Case Report. A A Pract. 2019 Oct 1;13(7):250-252. doi: 10.1213/XAA.0000000000001037. PMID: 31265444.
23. Asghar A, Salim B, Tahir S, Islam F, Khan MF. Awareness during Cardiopulmonary Resuscitation. Indian J Crit Care Med. 2020 Feb;24(2):136-137. doi: 10.5005/jp-journals-10071-23345. PMID: 32205947; PMCID: PMC7075066.
24. Chin KC, Yang SC, Chiang WC. Video of cardiopulmonary resuscitation induced consciousness during ventricular fibrillation. Resuscitation. 2020 Oct;155:22-23. doi: 10.1016/j.resuscitation.2020.07.006. Epub 2020 Jul 16. PMID: 32682850.

**Table 3. Review Studies:**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference** | **Design type** | **Question** | **Included** | **Rescuer reports** | **CPR type** | **sedation** | **Survival** |
| 1. Olaussen 2014 | Systematic review | Identify cases of CPR induced consciousness, and management strategies. | 9 cases of 10 patients | 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. |
| 1. Lunsguaard 2019 | Shortcut review | In patients who show signs of awareness during CPR are pain management 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) | 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 |
| 1. Pourmand 2019 | 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 | 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 the 10 patients in the case studies reported patient deceased. 3 Case studies reported total recall |

References:

1. Olaussen A, Shepherd M, Nehme Z, Smith K, Bernard S, Mitra B. Return of consciousness during ongoing cardiopulmonary resuscitation: A systematic review. Resuscitation. 2015 Jan;86:44-8. doi: 10.1016/j.resuscitation.2014.10.017. Epub 2014 Nov 4. PMID: 25447435.
2. Lundsgaard RS, Lundsgaard KS BET 2: Pain management in patients who show awareness during CPR Emergency Medicine Journal 2019;36:249-250.
3. Pourmand A, Hill B, Yamane D, Kuhl E. Approach to cardiopulmonary resuscitation induced consciousness, an emergency medicine perspective. Am J Emerg Med. 2019 Apr;37(4):751-756. doi: 10.1016/j.ajem.2019.01.051. Epub 2019 Jan 29. PMID: 30718119.

**Figure 1. Sedation Regimens:**

* 1) Rice Nebraska Protocol
  + 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 2-7 mcg/Kg/min
* 2) Dutch Ambulance service
  + When giving mechanical chest compressions
    - Fentanyl 2 mcg/Kg or Midazolam 2.5 mg
* 3) Wellington Free Ambulance service
  + If movement significant enough to interfere to resuscitation:
    - Ketamine IV 1 mg/Kg
    - If continuing significant movement rocuronium (if ETT in place)
* 4) Victoria, Australia ambulance protocol
  + If patient interferes with CPR, has present gag reflex, or appears to be aware:
    - Fentanyl 25 mcg IV, repeat every 3-5 min
    - If critical care trained Ketamine 20mg IV/IO, repeat every 3-5 min

References:

1. Rice DT, Nudell NG, Habrat DA, Smith JE, Ernest EV. CPR induced consciousness: It's time for sedation protocols for this growing population. Resuscitation. 2016 Jun;103:e15-e16. doi: 10.1016/j.resuscitation.2016.02.013. Epub 2016 Mar 5. PMID: 26956842.
2. Landelijk Protocol Ambulancezorg [Translate – Int’l Veld Dutch National Guidelines]. 2014; 8: 38 [Chapter 5.2].
3. Wellington Free Ambulance. Clinical Procedures and Guidelines; 2019-2022.Available from: https://www.wfa.org.nz/assets/What-we-do/b8a3986cc7/WFA-CPG-Comprehensive-2019-2022.pdf [accessed 15/01/2021]
4. Ambulance Victoria Clinical Practice Guidelines; page 47, Nov 2020. Available from https://www.ambulance.vic.gov.au/wp-content/uploads/2020/11/avcpg\_November\_2020.pdf [Accessed 17/01/2021]