

Cardiopulmonary Resuscitation in the Prone Position

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ABSTRACT

Cardiac arrest in unusual positions represents an additional challenge for anesthesiologists. This paper reports a successful cardiopulmonary resuscitation during neurosurgical procedure in which high-quality chest compressions was performed in the prone position. The aim of this report is disclose the knowledge of resuscitation maneuvers in a position other than supine. A 77-year-old female patient presented for excision of parietal-occipital meningioma in the prone position with the head fixed on a Mayfield head-holder. During the surgical procedure the sagittal sinus was disrupted. The patient presented an abrupt hemorrhagic shock leading to a cardiac arrest by hypovolemia despite vigorous volume replacement. Cardiac massage was promptly initiated in the prone position. After two minutes, there was a return of spontaneous circulation. The patient was discharged without sequelae. We concluded that high-quality chest compressions in the prone position were able to generate sufficient cardiac output.

Keywords: Cardiopulmonary Resuscitation; Prone Position; Cardiac Arrest

1. Introduction

Cardiac arrest is the outcome most feared by both anesthesiologists and surgeons, especially within the context of an elective procedure. Cardiac arrest in unusual positions, such as the prone position, represents an additional challenge primarily because the knowledge about the technique is not so release and the effectiveness of external chest compressions over the back has not recognizes widely. The current methods used are adapted from the technique of cardiopulmonary resuscitation (CPR) in the supine position. The learning about this issue is mainly based on case reports and there are no specific guidelines on how to proceed in these circumstances.

2. Case Report

A 77-years-old female patient, 155 cm, 53 kg, presented for excision of highly vascularized parietal-occipital meningioma on the right side. The patient was otherwise in good health. Preoperative haematological and biochemical investigations revealed no abnormalities. After basic monitoring and venipuncture, general anaesthesia was induced with midazolam, fentanyl and propofol. Tracheal intubation was facilitated by vecuronium and anaesthesia was maintained with oxygen and sevoflurane. Radial artery cannulation for direct arterial pressure monitoring and central venous catheterization by right subclavian vein was performed.

The patient was placed in the prone position. Cushions

were placed under the trunk and the head was fixed on a Mayfield head-holder with pins inserted into the skull. Five hours later, there was accidental rupture of sagittal sinus which led to an abrupt hemorrhagic shock. The bleeding amount was estimated in 3.0 liters in approximately 5 minutes. During the event, despite vigorous volume replacement started (1500mL of crystalloids plus 1000mL of colloid solutions), the patient developed severe bradycardia, decrease in PetCO₂ with MAP and pulse wave undetectable by invasive monitoring.

Cardiac massage was promptly initiated in the prone position with rhythmic manual compression to the medial portion of the thoracic spine. There was no counter-pressure sternal support. The frequency of compressions remained above 100 per minute, the PetCO₂ greater than 15 mmHg and DBP greater than 30 mmHg. After two minutes, there was a return of spontaneous circulation and hemodynamic parameters improved. Three hours later, the patient was transferred to ICU intubated with small doses of norepinephrine and was discharged from the ICU on the third postoperative day without sequelae.

3. Discussion

The technique of cardiac massage by external chest compressions (ECC) was developed for CPR in the supine position by Kouwernhoven *et al.* in 1960 [1]. Human studies on the effectiveness of resuscitation in the prone position have significant ethical obstacles but some

studies suggest that CPR in the prone position is most advantageous, generating higher blood pressures when compared to supine position [2-4]. Several case reports have confirmed that the posterior thoracic compressions are able to generate sufficient cardiac output.

The first case report of successful CPR in the prone position was described by Sun *et al.* in 1992. The report consisted of two neurosurgical cases of CPR after acute hypovolemia. Both cases were resuscitated with the technique named by the author as “reverse precordial compression maneuver” with one hand placed on the back of the patient, in the mid-thoracic spine, and the other hand placed on the lower third of the sternum serving as counter-pressure to the compression of the back. According to the author, that second hand can be replaced by rigid devices on the same site [5].

Several techniques have been described since: with or without counter-pressure device; with compressions either directly over the thoracic spine or adjacent to the thoracic spine on both sides if an incision is present.

Brown *et al.* reported a systematic review of literature and found only 22 cases of CPR in the prone position published from 1966 to 1999, with survival of 10 patients [6]. Since then, few cases have reported prone CPR in database Medline (2000-2010).

Dooney describes one case of sudden profound bradycardia and transient asystole during lumbar microscopic discectomy, which required initial CPR in the prone position [7]. Haffner *et al.* reported another case of CPR in the prone position during evacuation of cerebellar hematoma [8]. In both cases, the resuscitation was initiated in the prone position to decrease the no-flow-time. The return of spontaneous circulation (ROSC) started before turning the patient to the supine position. In some instances such as these reports, the cardiac arrest may be transient and turning the patient may not be necessary and resuscitation in the prone position was equally as effective as in the traditional position.

Beltran *et al.* present two cases of cardiopulmonary arrest and unsuccessful attempts at resuscitation after repositioning supine [9]. In these cases, the surgical site of bleeding became inaccessible after repositioning, leading to the question of whether prone resuscitation would have provided a better alternative. These cases suggest that the prone position should be considered as the optimal choice for CPR in certain limited circumstances, even if the supine position is achievable.

Even in VT/VF cases, there is successful ROSC after electric therapy in the prone position, without the necessity of repositioning the patient. Miranda *et al.* described a case in which electrical defibrillation was successfully performed in the prone position in a patient undergoing complex spinal surgery. They suggest that, if defibrillation were required in ventilated patients positioned prone,

defibrillation should be attempted in the prone position, as turning the patient supine would consume valuable minutes and reduce the chances of successful defibrillation [10].

Since 2005 the AHA Guidelines for CPR and ECC recommended that CPR in the prone position may be reasonable when the patient cannot be replaced in the supine position without prejudice, particularly in hospitalized patients with an advanced airway in place [11].

In 2010, the AHA Guidelines for CPR and ECC has not reviewed this issue [12]. However, the new guidelines increased focus on methods to ensure that high-quality CPR is performed by setting targets for rate and depth of compressions as well as minimum values obtained from the monitoring devices as capnography and continuous arterial line.

There is no specific recommendation on the frequency and depth of compressions to the patient in the prone position. Parallel to the recommendation given to patients in supination, in our case, the frequency was maintained above 100 cpm and depth sufficient to produce good perfusion indicators but without generating instability between the thoracic and cervical spine, which was fixed by Manfield head-holder.

The patient chest was not attached to the surgical stretcher. However, in the case described, we had the necessary monitoring to ensure that the ECC was being effective, fulfilling criteria of quality, despite the absence of sternal counter-pressure device. During the event, capnometry has remained above 15 mmHg and DBP greater than 30 mmHg. After two minutes of CPR in the prone position combined with volume replacement, there was a return of spontaneous circulation. The patient was discharged from the hospital seven days later after an uneventful recovery.

We conclude that resuscitation in the prone position was able to generate sufficient cardiac output while the correction of hypovolemia was performed, contributing to the good outcome achieved. In agreement with other authors, we believe that the immediate beginning of CPR, even in the prone position, is the best choice to these patients.

REFERENCES

- [1] W. B. Kuwenhoven, J. R. Jude and G. G. Knickerbocker, “Closed Chest Cardiac Massage”, *Journal of the American Medical Association*, Vol. 173, No. 10, 1960, pp. 1064-1067. [doi:10.1001/jama.1960.03020280004002](https://doi.org/10.1001/jama.1960.03020280004002)
- [2] J. A. Stewart, “Resuscitating an Idea: Prone PCR”, *Resuscitation*, Vol. 54, No. 3, 2002, pp. 231-234. [doi:10.1016/S0300-9572\(02\)00145-4](https://doi.org/10.1016/S0300-9572(02)00145-4)
- [3] S. P. Mazer *et al.*, “Reverse CPR: A Pilot Study of CPR in the Prone Position”, *Resuscitation*, Vol. 57, No. 3, 2003, pp. 279-285. [doi:10.1016/S0300-9572\(03\)00037-6](https://doi.org/10.1016/S0300-9572(03)00037-6)

- [4] J. Wei, "Cardiopulmonary Resuscitation in the Prone Position: A Simplified Method of Outpatients", *Resuscitation*, Vol. 62, No. 1, 2004, pp. 120-121.
[doi:10.1016/j.resuscitation.2004.03.007](https://doi.org/10.1016/j.resuscitation.2004.03.007)
- [5] W. Z. Sun *et al.*, "Successful Cardiopulmonary Resuscitation of Two Patients in the Prone Position Using Reversed Precordial Compression", *Anesthesiology*, Vol. 77, No. 1, 1992, pp. 202-204.
[doi:10.1097/00000542-199207000-00027](https://doi.org/10.1097/00000542-199207000-00027)
- [6] J. Brown, J. Rogers and J. Soar, "Cardiac Arrest during Surgery and Ventilation in the Prone Position: A Case Report and Systematic Review", *Resuscitation*, Vol. 50, No. 2, 2001, pp. 233-238.
[doi:10.1016/S0300-9572\(01\)00362-8](https://doi.org/10.1016/S0300-9572(01)00362-8)
- [7] N. M. Dooney, "Prone CPR for Transient Asystole during Lumbar Spinal Surgery", *Anaesthesia and Intensive Care*, Vol. 38, No. 1, 2010, pp. 212-213.
- [8] E. Haffner, A. M. Sostarich and T. Fösel, "Successful Cardiopulmonary Resuscitation in Prone Position", *Der Anaesthetist*, Vol. 59, No. 12, 2010, pp. 1099-1101.
[doi:10.1007/s00101-010-1785-8](https://doi.org/10.1007/s00101-010-1785-8)
- [9] S. L. Beltran and G. A. Mashour, "Unsuccessful Cardiopulmonary Resuscitation in Neurosurgery: Is the Supine Position Always Optimal?" *Anesthesiology*, Vol. 108, No. 1, 2008, pp. 163-164.
[doi:10.1097/01.anes.0000296716.56374.49](https://doi.org/10.1097/01.anes.0000296716.56374.49)
- [10] C. C. Miranda and D. C. Newton, "Successful Defibrillation in the Prone Position", *British Journal of Anaesthesia*, Vol. 87, No. 6, 2000, pp. 937-938.
[doi:10.1093/bja/87.6.937](https://doi.org/10.1093/bja/87.6.937)
- [11] ECC Committee, Subcommittees and Task Forces of the American Heart Association, "2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care," *Circulation*, Vol. 112, No. 24, 2005, p. 27.
- [12] American Heart Association, "2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care," *Circulation*, Vol. 122, No. 18, 2010, p. 721.