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CASE REPORT

CPR in prone position during neurosurgery

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ABSTRACT

Intraoperative cardiac arrest in usual position (prone or lateral) present a unique challenge to the anesthesiologist, where changing to supine position can result in undue delay in initiating CPR or it is not feasible due to skull being fixed and opened by the surgeon.

A 25 kg girl, 6 years old, was undergoing posterior cranial fossa surgery for fourth ventricle tumor excision. She went into hemorrhagic hypovolemic cardiac arrest, despite fluid resuscitation. Immediately, CPR was started in prone position with one hand at the midthoracic spine between the scapulae. The patient had ROSC after 20 min of CPR.

Our patient did not have a favorable outcome, but the resuscitation in the prone position generated sufficient cardiac output while the correction of hypovolemia and hemostasis could be achieved. We recommend that immediate initiation of CPR even in prone position is the best choice in intraoperative patients, where change in position would result in delay in chest compression or make the surgical access impossible.

Key words: Neurosurgery; Cardiac arrest; CPR; Prone position; ROSC; 2015 AHA CPR Guidelines

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INTRODUCTION

The incidence of cardiac arrest during non-cardiac surgery has been reported to be between 0.01-0.34%.[1,2,3] In a Japanese study, the main causes of intraoperative cardiac arrest include hemorrhage (31.9%), human errors (53%) and anesthesia related (22%).[4] The intraoperative patients are usually well monitored and early detection of cardiac arrest is possible. However, the cardiac arrest in unusual position (e.g. prone or lateral) presents a unique challenge to the anesthesiologist, where changing to supine position can result in undue delay in initiating CPR or it is not feasible due to non-accessibility to surgical field for the surgeon.

We, present a case of cardiac arrest during posterior cranial fossa surgery, where successful CPR was done in the prone position as change in the patient position was not practical in setting of ongoing massive blood loss and her skull being fixed with pins.

CASE REPORT

A 6 years old girl, weighing 25 kg girl was admitted for excision of a fourth ventricle tumor. Preoperative assessment revealed a history of headaches and repeated vomiting for the last three months. Her general physical and systemic examinations, as well as laboratory investigations were within normal limits. Based on her history, examination and laboratory investigation, ASA physical status II was assigned. She was taking oral dexamethasone and sodium valproate. She had undergone ventriculoperitoneal (VP) shunt placement under general anesthesia two months back. The surgery and anesthesia had been uneventful.

As part of her pre-operative optimization, oral dexamethasone was continued; cross matched blood

(RCC) one unit was arranged, bed availability confirmed in intensive care unit and surgery was planned.

On the day of surgery, IV access was achieved with a 22G and a 20G cannulae and maintained with 0.45% N/S in 5% D/W. Standard monitoring (heart rate, ECG, NIBP, SpO_2 and $EtCO_2$) along with invasive BP and urine output measurement, was started preoperatively. Patient was premedicated with inj dexamethasone 4 mg, metoclopramide 4 mg, and inj nalbuphine 3 mg. Induction was done with propofol 50 mg IV and muscle relaxation achieved with atracurium 10 mg. Endotracheal cuffed tube 4.5 mm was passed and secured after confirmation of bilateral air entry. Anesthesia was maintained with isoflurane in 50% oxygen. One unit RCC was at hand, at the time of incision (as per departmental protocol in posterior cranial fossa surgery).

The patient was placed in prone position. Cushions were placed under the chest and pelvis. The head was fixed with pins inserted into the skull. The surgery was started, and as soon as the dura was opened, there was torrential blood loss —with loss of almost 1.0 liter in less than 5 min. Despite vigorous fluid resuscitation (including 300 ml RCC, 500 ml Haemaccel™ (Polygeline. 3,5% colloidal infusion solution) and 500 ml crystalloid solution), the patient went into severe bradycardia, undetectable $EtCO_2$ and IBP. Instantaneously, CPR was started while the patient was still in prone position and the surgeon was asked to dislodge head pins. The cushion under the thoracic region was thought as sternal counter pressure and manual chest compression given at thoracic spine; with fluid resuscitation continued. The surgeon secured hemostasis and closed the wound. The patient had return of spontaneous circulation (ROSC) after 20 min, with stabilization of hemodynamic parameters. The quality of CPR was assessed by $EtCO_2$ greater than 10 mmHg at all times. The estimated blood loss was 2.0 L and a total of 3100 ml fluid (including 1000 ml normal saline, 500 ml Haemaccel™ (Polygeline. 3,5% colloidal infusion solution), 900 ml RCC and 700 ml pediatric electrolyte solution) was given intraoperatively.

The patient was shifted to ICU on mechanical ventilation with ETT in place. On reception in ICU, her pulse was 128/min, BP 127/84 mmHg, SpO_2 98% with FiO_2 of 100%, temperature 37° C. she was kept sedated and paralyzed and placed on mechanical ventilation; CMV mode with vital volume of 180ml, 20 respiratory rate, PEEP of 5 cmH_2O and FiO_2 of 100% (titrated to 45% maintain SpO_2 > 94%). Her Blood CP, PT/ PTTK, serum urea and creatinine remained within normal limits.

She remained vitally stable. She was fulfilled the criteria for extubation, so sedation and relaxants were stopped and a trial of weaning was given. She had eye opening and limb movements 24 hours postoperatively. However, she became severely tachypneic after 30 min of initiation of weaning trial. She was sedated and paralyzed and placed again on mechanical support: SIMV mode, Tv - 250 ml, respiratory rate - 20/min, FiO_2 - 40% and 5 cmH_2O PEEP. The patient had bled by about 2.0 L over 20 minutes intra-operatively and surgical opinion was asked for, which the surgeon opted for conservative treatment rather than re-exploration as prognosis was judged to be very poor. Her condition deteriorated over the next few days and she died on 5th postoperative day.

DISCUSSION

The current technique of external chest compression in supine position during CPR was developed in 1960.[5] Not much literature is available regarding guidelines for CPR in prone position. Several case reports have been found that chest compressions are effective even in prone position.

The first report of successful CPR in prone position was described by Sun et al. in 1992. They presented two case reports of CPR during neurosurgery. In both cases, chest compression were done with one hand placed in the midthoracic region while other hand placed on lower third of sternum.[6] Daiana et al. presented a case report of successful CPR in prone position on a 77 year old lady undergoing neurosurgery. The patient had cardiac arrest due to hemorrhagic hypovolemia due to accidental opening of sagittal sinus. The patient had ROSC after two minutes of CPR with rapid fluid resuscitation.[7]

Mazer et al. studied the mean improvement in blood pressure between chest compression in supine and prone position. The mean SBP had an improvement of 23 ± 14 mmHg, the mean MAP improvement was 14 ± 11 mmHg and the mean DBP improvement was 10 ± 12 mmHg, However, the results were not statistically significant.[8]

Similar results were observed in a study done by Wei J. et al. with cadaveric CPR in intensive care unit in both supine and prone position with blood pressure recorded by invasive intra-arterial line. They found that the generated blood pressure was higher in prone

CPR as compared to standard supine CPR (79 ± 20 / 17 ± 10 mmHg; p value 0.028).[9] However, neurological assessment, central venous and arterial access are limited in prone position.[10]

The 2005 AHA guidelines for CPR recommended that CPR in prone position may be reasonable if the patient cannot be positioned in the supine position, without prejudice.[11] In the 2010 and 2015 AHA guidelines for CPR, external chest compression in prone position have not been reviewed. The current guidelines recommend to perform CPR in supine position and limit the use of prone chest compressions to situation where patient cannot be turned to supine and its utility is restricted to hospitalized patients (already in prone position) with advanced airway in place.[12]

There are no latest recommendation regarding the frequency or depth of compressions to patients in prone position. Keeping in mind the recommendations for patients in supine positon, we performed chest compressions at rate of 100-120 per minute with ventilation through anesthesia machine at the rate of 12 breaths per minute.

The patient's head was released from the head pins to prevent damage to the cervical spine. The quality of CPR was continuously assessed by $EtCO_2$ and arterial BP monitoring.

There are two techniques of *hand placement* for chest compression in prone position. First is placing one hand (similar to supine compressions in adults) on the midthoracic spine and the second, bilateral open palms on the space between the scapula and thoracic spine.[13] We used the 'hand on the midthoracic spine', at the interscapular region.

During prone CPR, a sternal counter-pressure is recommended, usually by placing a 4.5 kg sandbag or 500 ml IV fluid bags or gel filled pads in adults.[9] It allows for improved quality of compressions due to two reasons. Firstly, the strength of thoracic costovertebral joints is greater as compared to sternal costochondral junction. Secondly, the abdominal contents are not displaced anteriorly, resulting in better chest compressions.

In our case, the patient had ROSC after 20 min of CPR. During this time, the surgeons were able to achieve hemostasis; which would not have been possible had the patient's position been changed for CPR.

CONCLUSION

Resuscitation in the prone position in our patient was able to generate sufficient cardiac output while the correction of hypovolemia and hemostasis could be achieved. Unfortunately, our patient did not have a favorable outcome. We recommend that immediate initiation of CPR even in prone position is the best choice in intraoperative patients, where change in position would result in delay in chest compression or make the surgical access impossible.

Conflict of interest: Nil

Author contribution: All authors shared the concept, conducted the case and took part in manuscript writing.

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