

Cardiopulmonary Resuscitation in the Lateral Position: Is It Feasible during Pediatric Intracranial Surgery?

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INTRAOPERATIVE cardiac arrest during neurosurgical operations can occur after massive blood loss in adults and in children.^{1,2,3,4} Many of these procedures are performed in positions other than supine, and this could pose a major hurdle in successful resuscitation.³ The practice of turning the patient supine for cardiopulmonary resuscitation (CPR) during neurosurgical operations has recently been questioned.⁵ Although successful resuscitation has been reported in the prone position, there are no studies available on the feasibility of CPR in the lateral position. This is a case report of cardiac arrest due to massive blood loss in a child undergoing excision of a large brain tumor in the lateral position followed by successful resuscitation in the same position.

Case Report

A 6-yr-old boy (height, 103 cm; weight, 18 kg) with clinical features of severe intracranial hypertension on ventilatory support was referred to this hospital for definitive management. Magnetic resonance imaging revealed a large and vascular right intraventricular tumor. The child suffered a cardiac arrest in the intensive care unit the day before surgery. He was successfully resuscitated and scheduled for emergency craniotomy under American Society of Anesthesiologists grade IV. On the day of surgery, his pulse rate was 130 beats per minute, blood pressure was 130/80 mmHG, and he was on pressure support ventilation. He had normal-sized pupils that were reacting to light and normal flexor motor response and spontaneous respiratory efforts. The child was placed in the left lateral decubitus position with the head resting on a doughnut for surgery. Intraoperative monitoring included intraarterial blood pressure and central venous pressure. During surgical decompression of the tumor, there was sudden and rapid blood loss associated with bradycardia (50–60 beats per minute) and severe hypotension and hypovolemia (systolic blood pressure, 30–40 mmHG; central venous pressure, –5 mmHG) followed by pulseless electrical activity. External cardiac massage was commenced in the lateral position itself using the two thumb-encircling hand technique to avoid any delay in resuscitation. This technique of CPR produced a pulsatile arterial trace and systolic pressures of approximately 50–60 mmHG, Epinephrine boluses along with rapid transfusion of blood products and inotrope infusions (dopamine and adrenaline) were administered.

Life-sustaining rhythm and blood pressure (70–80 mmHG) were obtained within 3 min. One hour later, during hemostasis, the child had another episode of severe hypotension for which similar resuscitative measures were taken. After both episodes of successful resuscitation, the surgeon could proceed with tumor decompression and hemostasis. The surgery lasted 4 h and the blood loss was 1 l, which was replaced. At the end of surgery, he was shifted to the intensive care unit in a stable hemodynamic condition. Inotropic support was tapered off by the third postoperative day, and he was weaned off the ventilator on the eighth postoperative day. At the time of discharge to a peripheral hospital a week later, he had spontaneous eye opening, was able to localize to painful stimuli, was on room air through a tracheostomy, and on Ryle's tube feeds.

Discussion

Cardiovascular collapse during neurosurgical operations is not uncommon, especially in patients with large, vascular tumors, where blood loss can be torrential.^{6,7} This is especially true in children undergoing neurosurgery, where profuse blood loss can cause life-threatening hemodynamic instability. Many of these operations are performed in the sitting, lateral, and prone positions, hindering conventional resuscitation and further compounding the dangers associated with cardiovascular instability.³ There are many reports of patients undergoing neurosurgical operations in whom CPR was unsuccessful despite repositioning them supine.^{5,8,9,10} Repositioning these patients is difficult because gathering sufficient staff to safely turn the patient with an open wound and whose head may be fixed on pins with various invasive monitoring catheters *in situ* can delay CPR by as long as 5 min.¹¹ Moreover, there is also the possibility of neural damage during emergency repositioning.³ Another disadvantage associated with repositioning the patient is the inaccessibility of the surgical site after resuscitation, which could prevent the surgeon from addressing the cause of cardiovascular instability.⁵

There are several reports of favorable outcome after prone resuscitation in neurosurgical patients. It was first reported by Sun *et al.*, who used reverse precordial compression by placing a clenched fist under the sternum while compressing the midthoracic spine with the right hand in patients undergoing neurosurgery.⁴ A modified technique of CPR by compressing the thorax on both sides of the surgical incision against the frame was used in a child undergoing spinal fusion.¹² In yet another report in an achondroplastic infant undergoing foramen magnum decompression, a sandbag under the chest provided counterpressure, and fingers over the thorax were

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used for compression during CPR.¹³ In all these patients, successful CPR could be performed without repositioning the patients supine. Brown *et al.*, in a review of 22 cases of CPR conducted in prone position, found rapid blood loss to be the contributory factor in half of the patients.³ They recommend repositioning to the supine position for CPR only if initial resuscitation in the prone position is unsuccessful. Prone CPR has been recommended by the 2005 American Heart Association Guidelines for CPR and Emergency Cardiovascular Care in situations when the patient cannot be placed supine.¹⁴

Cardiopulmonary resuscitation in the lateral position during operative procedures has not been hitherto reported. In a recent report of two neurosurgical cases operated in the lateral position who sustained cardiac arrest after rapid blood loss, CPR was unsuccessful after repositioning them supine because of ongoing blood loss.⁵ These authors concluded that, even if the supine position is achievable, CPR should be carried out in the prone position so that access to the surgical site may be preserved and hemostasis facilitated. In this child, CPR was initiated without any delay in the lateral position itself using the two thumb-encircling hand technique of chest compression.¹⁵ This was not only successful, but it also avoided contamination and trauma to the surgical site which could have occurred with a hasty change of position in a patient with an open surgical wound. However, so far there are no studies of CPR in the lateral position to document its true efficacy.

In conclusion, CPR during neurosurgery in positions other than supine is fraught with difficulties mainly because of problems associated with repositioning and consequent delay in resuscitation. As seen in this child, CPR in the lateral decubitus position using the two thumb technique may be a feasible initial option; only if

this fails, should one consider repositioning them supine or prone.^{3,5} This would permit institution of resuscitation without delay and avoidance of serious cardiac and neurologic sequelae. Further studies on CPR in the lateral decubitus position are needed to ascertain its efficacy.

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