Anesthesia For Off Pump Bidirectional Glenn Shunt Surgery: Case Report.

F Onyekwulu, N Ramados, P Kandakure

Abstract

The purpose of this case report was to enumerate the challenges confronted by the anesthesiologist while conducting anesthesia for Bidirectional Glenn Shunt (BDGS) surgery and discuss the complications that could arise from this procedure.The patient presented with multiple congenital heart anomalies and cyanosis. Off- pump BDGS surgery was carried out under general anesthesia. Surgery and anesthesia were uneventful.

INTRODUCTION

Bidirectional Glenn shunt (BDGS) is a surgical procedure performed for cyanotic congenital heart diseases where biventricular repair is not feasible and ultimately lead to single or one and half ventricle physiology. The end-to-side anastomosis of the superior vena cava (SVC) to the right or left pulmonary artery effectively increases arterial blood oxygen saturation and decrease the ventricle volume overload[1]. This procedure poses enormous challenge to the anesthesiologist particularly when it is performed without cardiopulmonary bypass (off-pump). This case is reported to enumerate those challenges and how they were managed.

CASE REPORT

A 8 year old female who presented to the hospital with a history of exertional dyspnea, bluish discoloration of lip, palm, and sole of the feet which started at 6 month of age. The symptoms were exersabated by eating and crying. She was delivered at full term by spontaneous virginal delivery. On examination she weighed 19 kg, height was 113 cm, heart rate (HR) of 110 beats per minute (b/m), blood pressure of 108/74mmHg, arterial oxygen saturation (SpO2) of 86%. Heart sounds 1 and 2 were heard with an ejection systolic murmur grade 5/6. Electrocardiogram showed right ventricular hypertrophy, right axis deviation and a prolonged PR interval. A 2-dimentional echocardiography made a diagnosis of L-transposition of great arteries, large perimembraneous ventricular septal defect, large osteum secundum atrial septal defect, severe pulmonary stenosis, regressed left ventricle. Other investigations carried out were chest X-ray, random blood sugar, full blood count and

electrolyte and urea. She was then worked up for surgery (BDGS). Airway assessment revealed Mallampati class1, she was graded ASA (American Society of Anesthesiologist) physical status IV and NYHA (New York Heart Association) grade II.

In the operating room, a peripheral venous access was secured, monitoring of ECG, pulse oximetry, nasopharyngeal temperature and non-invasive blood pressure was started. General anesthesia was induced with intravenous 5% sodium thiopentone 100mg and fentanyl 50μg; pancuronium 2 mg, was administered to facilitate tracheal intubation with a 5.5-mm ID cuffed endotracheal tube, with the aid of laryngoscope after 3 minutes of preoxygenation. Controlled mechanical ventilation started with a tidal volume of 190 ml and respiratory rate of 18 per minute. Anesthesia was maintained with isoflurane (1%) in oxygen / air mixture, fentanyl 100 μg, midazolam 2 mg, and pancuronium 1 mg. Right femoral artery and vein (multi-port) were cannulated for monitoring the arterial blood pressure (ABP); and right atrial pressure, inotrope and fluid infusion respectively. Right internal jugular vein was cannulated to monitor the superior vena cava (SVC) pressure (SVP/ pressure within the Glenn shunt). The monitored ABP was 93/52, central venous pressure (CVP) 7 mmHg and end-tidal carbon dioxide ($EtCO_2$) level was 32mmHg.

The surgery was carried out through a standard median sternotomy. Arterial blood gas was analyzed at baseline after tracheal intubation, when the cava was clamped and half an hour after de-clamping. Intraoperatively, direct pulmonary artery (PA) pressure was measured (15mmHg) and the body

temperature was maintained at 33-34°C. The SVC, the left innominate vein and the right PA were dissected. The right PA was trial clamped for a few minutes to check for changes in arterial oxygenation. After systemic heparinization [1mg/kg] to keep activated clotting time (ACT) more than 200 seconds, the innominate vein (18Fr) and the right atrial appendage (24Fr) were cannulated, connected through a three-way connector and carefully de-aired. With the shunt open and the head-end elevated, the SVC was clamped at right atrial end and near the innominate insertion (SVP rose to 26mmHg) and divided and anastomosed to the right PA. The clamps were released to allow the Glenn shunt to flow. A decision was made to allow some forward flow across the pulmonary valve based on the Glenn pressures. Clamp time was 15 minutes; sodium bicarbonate 10ml was administered. Pacing wires were placed electively. Hemostasis was achieved after decannulation and chest was closed as routine with chest drains.

During the procedure hemodynamic instability was managed with infusions of dopamine 3μg/kg/minute, dobutamine 5μg/kg/minute, sodium nitroprusside 0.5-1ml/hr and colloid (hydroethyl starch).

Post BDGS the ABP was 97/52, SVP 15mmHg, SpO_2 98% at fractional inspired oxygen (FiO_2) of 0.8, left atrial pressure (LAP) 7-9mmHg, $EtCO_2$ 27mmHg, HR 121 b/m, sinus rhythm. Protamine 20mg and then 2 units of fresh frozen plasma were administered. The ACT at the end of procedure was 108 seconds.

The patient was transferred to the intensive care unit (ICU) where she was on ventilator for 8 hr and weaned off. The patient was started on heparin for the first 24 hours post surgery and subsequently covered with aspirin. Inotropic support continued for 14hr and she was discharged from ICU after 48hr (chest drains removed) and home after 7 days.

DISCUSSION

Intra-operative co-ordination with the anesthesiologist remained the mainstay of a successful shunt assisted off-pump BDGS.

The exposure of infants or children to the effects of hemodilution, microemboli, or complement activation [2] may be minimized when bidirectional Glenn procedures are performed without CPB. [3] However, intracranial blood volume increases as a consequence of SVC clamping, thereby increasing intracranial pressure and decreasing cerebral perfusion. [4]

The temperature was allowed to drift to 33-34°C to assist in cerebral protection. Inotropes and volume replacement were used to maintain adequate cerebral blood flow and a higher transcranial pressure gradient (>30 mm Hg)[3] during clamping. The use of cerebral function indicators(transcranial Doppler ultrasonography, near-infrared spectrophotometry, and electroencephalography or middle latency evoked responses)[5],to complement hemodynamic information regarding cerebral effects of SVC clamping during off-pump BDGS is paramount to actually establish the state of brain function during the procedure.

When SVC is clamped, blood flow to the brain (Cerebral perfusion pressure = Mean arterial pressure - CVP) is impaired. Veno-venous shunt help drainage of SVC and improve cerebral perfusion[1].

Hypoxic episodes were managed by increasing the FiO_2 and optimizing inotropes and colloids to enhance the mean arterial pressure and hence flow to the lungs[1].

Postoperative management was aimed at decreasing the pulmonary vascular resistance and accelerating the SVC return. In patients with higher Glenn pressures, inodilators help in lowering the mean PA and left ventricular end-diastolic pressures.

Careful monitoring of transpulmonary gradient (CVP-LAP) and evidence of systemic venous congestion is essential as CVP above15 to 18mmHg or transpulmonary gradient above 10mmHg indicates difficulty with passive flow of blood across pulmonary capillary bed[1].

Early weaning of the patient from ventilator and extubation should be facilitated as prolong ventilation would result in increase intrathoracic pressure, impaired venous return and shunt flow. Aggressive diuresis and salt restricted diet were a regular part of postoperative care[1].

CONCLUSION

Administering anesthetics during off-pump BDGS is very challenging. Monitoring of hemodynamic variables is paramount; maintaining adequate cerebral blood flow and transcranial pressure gradient during clamping is the key to good outcome.

References

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Author Information

Fidelis A. Onyekwulu, MBBS, FMCA
Consultant Anaesthesiologist, Department of Paediatric Cardiac Anaesthesiology, Innova Children's Heart Hospital

Nagarajan Ramados, MD, FNB
Consultant paediatric cardiac Anaesthesiologist, Department of Paediatric Cardiac Anaesthesiology, Innova Children's Heart Hospital

Pramod R. Kandakure, MS, MCH
Consultant paediatric cardiac Surgeon, Department of Paediatric Cardiac Surgery, Innova Children's Heart Hospital