Anaesthetic management of an unrecognized cerebral arteriovenous malformation bleed in a 45-day old baby

INTRODUCTION

Cerebral arteriovenous malformation (AVM) is a congenital malformation between the arteries and veins that produces low resistance high flow shunt. AVMs, often presents between 20 and 45 years of age with the peak incidence at 4th decade. Only 18-20% of AVMs are diagnosed during infancy and childhood and manifests with an intracranial bleed in about 70-80%.\(^1\) Despite the advancement in the technology, reported morbidity and mortality after AVM surgery is high.\(^2\) We report a case of successful management of unrecognized cerebral AVM bleed in an infant requiring massive transfusion with the guidance of pulse pressure variation (PPV).

CASE REPORT

A 45-day-old male baby (weight 4 kg) was admitted with a history of poor feeding and an irritable cry. On examination, the anterior fontanelle was full with a head circumference of 36 cm. The child's Glasgow Coma Scale (GCS) score was 10/15 (E3V2M5). There was scissoring of the legs with an ill-sustained clonus. Routine blood investigations were within normal limits except for low hemoglobin (Hb) of 8 g/dl. The partial thromboplastin time (PTT) was 44, while the prothrombin time (PT) was 19.3 with the International Normalized Ratio (INR) being 1.6. Computerized tomography (CT) of brain (plain) showed a left frontoparietal hematoma measuring 6 × 4.5 cm with a midline shift of 13 mm [Figure 1].

A clinical diagnosis of hemorrhagic diseases of the
new born was considered. As the child had a large hematoma associated with midline shift, it was decided to evacuate the hematoma after correcting the PT, PTT, and Hb. After correcting the PT, PTT, and Hb with 150 ml of fresh frozen plasma (FFP) and 100 ml of packed red cells, the child was taken to the operating room (OR).

In the OR, electrocardiography (ECG), non-invasive blood pressure (NiBP) and pulse oximetry (SPO2) were established. The child was induced with 2 μg/kg of fentanyl, 5 mg/kg of thiopentone and was paralysed with atracurium (0.5 mg/kg). The airway was secured with a 4 mm uncuffed endotracheal tube (ETT). Anaesthesia was maintained with air, oxygen (FiO2 - 40%) and isoflurane (MAC 0.9-1). Left femoral arterial line (20 Gauge) and a right-sided 5F triple lumen femoral venous catheter were inserted. Baseline PPV (10-12) and central venous pressure (7-8 cm of H2O) were noted. Intraoperative fluid administration was guided by the PPV (Philips IntelliVue MP 70™).

As there was a significant blood loss during craniotomy, blood transfusion was started from the beginning of surgery. Durotomy was associated with significant bleeding and drop in blood pressure from 90/55 to 45/25 mm of Hg, with a heart rate of 120/min. This was initially treated with fluid and ephedrine (0.5 mg) boluses. Since there was an ongoing blood loss, low dose adrenaline (0.03 μg/kg/min) was started to support the circulation while resuscitating with blood, FFP. After the durotomy, a large AVM was identified. As there was bleeding from the AVM, surgeon decided to go ahead with excision of the AVM. While resecting the AVM, the child lost more than 2.75 times the blood volume (>850 ml), which was replaced with packed cell, FFP, cryoprecipitate and platelet in the ratio of 1.5:1:1:1. Serial Hb, coagulation profiles (PT, PTT, platelets, fibrinogen), arterial blood gas (ABG), electrolytes were done intraoperatively [Table 1]. After 1.5 times of blood volume loss, a single bolus dose (10 mg/kg) of Tranexamic Acid (TA) was given.

During the intraoperative period, the PPV varied from 10 to 13. However, during the period of sudden blood loss associated with hypotension, the PPV reached a maximum of up to 25-30. During these episodes, 50-60 ml of fluid was given, which brought down the PPV to less than 13. We did not measure CVP during the intraoperative period as the CVP port was used for administration of adrenaline. The other two lumens were used for giving blood products. Adrenaline infusion was tapered and stopped once the hemostasis was achieved. Normothermia (36-37°C) was maintained using a warm blanket (Bair Hugger™ 505) and warmed fluids (fluid warmer - Animec AM2S™) during the procedure. The urine output was >30 ml/h throughout the

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**Table 1: Hb, coagulation parameters, electrolytes and ABG in the intraoperative period**

| Parameter            | Preoperative period | 90 min after skin incision | 180 min after skin incision | At the end of surgery |
|----------------------|---------------------|-----------------------------|-----------------------------|-----------------------|
| Hb (g/dl)            | 8.0                 | 8.9                         | 9.5                         | 12.8                  |
| Platelets (no/cu ml) | 409000              | 226000                      | 106000                      | 240000                |
| PT (s)/INR           | 19.3/1.6            | 9.9/0.9                     | 14.5/1.3                    | 10.9/1.02             |
| PTT (s)              | 44.8                | 27.3                        | 40.9                        | 29                    |
| Fibrinogen (mg/dl)   | 349                 | 230                         | 140                         | 284                   |
| Na/k (meq/l)         | 131/5.2             | 142/3.3                     | 143/3.2                     | 144/3.8               |
| PH                   | -                   | 7.327                       | 7.349                       | 7.430                 |
| PaCO₂ (mm of Hg)     | -                   | 36                          | 39                          | 44                    |
| PaO₂ (mm of Hg)      | -                   | 162                         | 151                         | 183                   |
| HCO₃ (meq/l)         | -                   | 20                          | 24                          | 27                    |
| Base excess           | -                   | -5.1                        | 2.1                         | 4.5                   |
| SaO₂ (%)             | -                   | 99                          | 98.7                        | 99.6                  |

INR – International normalized ratio; PTT – Partial thromboplastin time; PT – Prothrombin time; Hb – Hemoglobin; ABG – Arterial blood gas
surgery. Postoperatively, the child was ventilated for 48 h and then extubated. Biopsy of the specimen was consistent with vascular malformation. At the 12 months follow-up period; the child had no delay in milestones or deficits.

**DISCUSSION**

Management of acute massive blood loss in an infant is very challenging. The various dynamic parameters like systolic pressure variation (SPV), stroke volume variation (SVV), PPV and static parameters like global end diastolic volume (GEDV) and central venous pressure (CVP) are used to assess the fluid responsiveness during surgery. Recent studies have shown that the PPV, SPV, SVV are superior to CVP, GEDV for assessing the fluid responsiveness.[3,4] Renner et al.[5] showed that the PPV-guided fluid management increased the stroke volume index better, compared to SVV-, CVP-, GEDV-guided fluid management in congenital cardiac surgery. In our case, the PPV was used to guide the fluid administration in a massive blood loss scenario and helped us to manage well without acid base abnormalities or cardiopulmonary complications. The PPV value reached 30 during the episodes of hypotension associated with blood loss and returned to baseline with fluid bolus of 15 ml/kg.

There are reports of use of TA in pediatric neurosurgery.[6] The routine use of TA in neurosurgery is not recommended due to an increased risk of thrombosis leading to cerebral ischemia and seizures due to GABA inhibition.[7] In our case, there were no complications noted with the use of TA.

**CONCLUSION**

The PPV is a reliable tool for guiding fluid management in an infant during massive blood loss scenario. Adequate preparation with an intravascular access, blood and blood products help to prevent intraoperative adverse event.

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**InTRODUCTIOn**

Incidence of congenital cardiac defects with eye involvement could be as high as 95%. Dexmedetomidine is an α2-receptor agonist, which can be a useful adjuvant in paediatric cardiac anaesthesia.[1] Besides its favourable sedative and anxiolytic properties it attenuates haemodynamic and neuroendocrine responses to surgical trauma. Use of dexmedetomidine in ophthalmic surgeries for its reducing effect on intraocular pressure (IOP) is also well-documented.[2] In this baby, effects of...