Case Report

Anesthetic Considerations for Ventriculoatrial Shunt Insertion in a Child with Cerebrospinal Fluid Ascites

Rajeeb K. Mishra, Arvind Chaturvedi, Bhagya R. Jena, Girija P. Rath

Department of Neuroanaesthesiology and Critical Care, All India Institute of Medical Sciences (AIIMS), New Delhi, India

Cerebrospinal fluid (CSF) ascites is a rare complication of ventriculoperitoneal (VP) shunt insertion and occurs as a result of inability of peritoneum to absorb CSF. Insertion of ventriculoatrial (VA) shunt is considered to be the management of choice in such cases, as an alternative method of CSF diversion. The perioperative management in such scenario revolves around the appropriate diagnosis of the condition, preoperatively. Other causes of ascites are needed to be ruled out as the resultant clinical condition may also affect anesthetic management. In this case, we highlighted the importance of preoperative evaluation, anesthetic management, and the approach to postprocedural care.

Case Report

A 7-year-old male child weighing 25 kg was admitted to our neurosurgical unit with complaints of abdominal distension for 5 months and on-and-off vomiting for 3 months. He had no other comorbidities and neither the child complained of breathlessness. The child underwent craniotomy and excision of hypothalamic glioma 4 years back, which was followed by right VP shunt insertion for hydrocephalus. He also underwent a revision surgery with programmable shunt set at a pressure of 80 cmH₂O. He was on thyroxine and prednisolone as hormonal supplementation. On examination, there was a distended abdomen, with everted umbilicus and engorged veins [Figure 1]. The abdomen was tense and fluid thrill was present; on percussion, the resonance was dull in character. Respiratory system examination did not reveal any significant abnormality. The child was associated with sinus tachycardia with baseline heart rate 110 beats per min and left arm supine blood pressure was 90/60 mm Hg. His all routine investigations including hemogram, renal function tests, and liver function tests were within normal limits. Computed tomographic scan of head revealed shunt in situ. The child was diagnosed as a case of CSF ascites and scheduled for a VA shunt procedure under general anesthesia.

In the operating room, all the routine monitors were connected and the child was premedicated with glycopyrrolate and induced with fentanyl 2 µg/kg, propofol 2 mg/kg, and rapid sequence tracheal intubation after rocuronium 1 mg/kg. The child was then connected to ventilator with a fresh gas flow of 2 L/min, flow and anesthesia was maintained with sevoflurane.

Address for correspondence: Prof. Girija Prasad Rath, Department of Neuroanaesthesiology and Critical Care, Neurosciences Centre, All India Institute of Medical Sciences (AIIMS), New Delhi 110029, India. E-mail: girijarath@yahoo.co.in

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and oxygen–air mixture. A left radial arterial catheter was inserted to assess the acid–base status. The child had a decreased saturation and partial pressure of arterial oxygenation (SaO₂ 95%; PaO₂ 64 mmHg) with 50% inspired oxygen concentration. The shunt was placed in the right atrium after identifying sixth thoracic vertebra with the help of fluoroscopy [Figure 2]. At the end of procedure, the trachea was extubated after reversal of residual neuromuscular blockade. Postoperatively, the child was monitored in the neurointensive care unit; his chest x-ray showed presence of shunt in the right atrium [Figure 3]. On second postoperative day (POD), 1 L of ascitic fluid was tapped to make the child comfortable, and the sample was sent for biochemical analysis, which showed an elevated protein level. However, there was no evidence of fever or tachypnea during this period. The child received a 5-day course of injectable antibiotics such as cefotaxime and netilmicin before being discharged on 13th POD from the hospital with an advice for follow-up.

**DISCUSSION**

CSF ascites is a rare complication of VP shunt placement, and in this case an elective VA shunt was performed to revise and divert the CSF flow into right atrium. Preoperative evaluation of such children is of paramount importance in ruling out other possible causes of ascites. A thorough systemic examination involving hepatic, renal, and cardiac systems helped us to ruling out other possible causes of ascites. Moreover, any of the systemic problems can affect the pharmacokinetics of anesthetic agents utilized.

Most of the CSF diversion procedures are carried out with an underlying hydrocephalus and increased intracranial pressure (ICP), which warrant significant considerations while induction of anesthesia. This child presented with vomiting on and off, suggestive of raised ICP. Hence, a rapid sequence intubation was considered for a possible raised ICP as well as obvious increase in intragastric pressure due to ascites. Sometimes such patients present with dyspnea and are prone to rapid deoxygenation under general anesthesia owing to reduced functional residual capacity, and also because of their higher metabolic rate for oxygen consumption. In this case, the child presented with hypoxemia (decreased PaO₂) on blood gas analysis, attributable to basal atelectasis and hence, increased shunt fraction. The hypoxemia, subsequently, improved on addition of positive end-expiratory pressure of 5 cmH₂O. To counter these effects, a preoperative drainage of ascitic fluid should be considered. However, the drainage procedure may become a potential source of infection;
hence, it was not considered in this case. Trendelenburg position may help better surgical exposure of internal jugular vein (IJV) through which the shunt is placed in the atrium. However, it may negatively affect the ventilation and this has to be borne in the mind.

The child had basal sinus tachycardia, which could be attributable to decreased venous return from the lower half of body owing to increased abdominal pressure and hence, inferior vena caval compression, which was evident by the engorged superficial veins. The tachycardia could also be following a fluid-deficient state as a result of ascites; however, a pulse pressure variation less than 10% in this child ruled it out. It should also be borne in mind that the surgical dissection may lead to possible injury to internal carotid artery and the sympathetic plexus surrounding to it. Tachycardia and hypertension while dissection are frequent findings attributable to manipulation of the sympathetic plexus. Venous air embolism is also a possibility as the IJV is opened for catheter insertion,[3] which justifies avoidance of nitrous oxide in these cases. Arrhythmias may occur while introducing the shunt catheter.[3] Intraoperative fluoroscopy is usually required to guide placement of shunt in the atrium. Transesophageal echocardiography may be utilized for this purpose if an appropriate-sized probe is available.[4] The shunt surgery carries a significant risk of surgical infection and complicated treatment thereof; preoperative antibiotics, adherence to aseptic precautions, and other measures to minimize the risk of infection are essential. An elevated protein level in ascitic fluid sample without fever is suggestive of underlying inflammation. There have been reports of shunt-induced immune-complex glomerulonephritis[5] with chronic shunt infection–related immune-complex deposition in glomerulus as the possible explanation. Generally, the glomerulonephritis responds immediately to externalization of the shunt and appropriate antibiotic coverage.[5,5] A catheter within the atrium may cause chronic microembolization and may lead to pulmonary hypertension. Given the prevalence of subclinical thromboembolism, pharmacologic anticoagulation remains a strong consideration that should be individualized. The American Heart Association finds no convincing evidence that periprocedural prophylaxis is indicated in patients undergoing VA shunt insertion.[3] There are complications of VA shunts such as endocarditis, wound or CSF shunt infection, and shunt malfunction, reported in the literature.[5] Superior vena caval thrombosis is a rare complication of VA shunt procedure.[6] Hence, long-term follow-up is necessary of such patients.

In conclusion, we successfully managed a child with CSF ascites undergoing VA shunt placement. In this context, the role of preoperative evaluation in differentiating all possible causes of ascites, proper anesthetic planning, and a long-term postprocedural follow-up to improve outcome, may not be overemphasized.

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Conflicts of interest
There are no conflicts of interest.

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