Review Article

Anaesthesia for VP Shunt Surgery

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Abstract

VP Shunt is one of the most commonly performed neurological surgeries.The patients undergoing this procedure may vary in age from neonates to elderly; they may be fully conscious or neurologically impaired. Knowledge of specific considerations of these patients will help the anesthesiologist to manage these patients in a better way.

Keywords: Hydrocephalus, VP shunt, Neuroanaesthesia

Introduction

Ventriculo-peritoneal (VP) shunting is performed in patients of varying ages, i.e., from neonates to elderly. It involves draining cerebrospinal fluid (CSF) from ventricles to peritoneal cavity using a device known as VP shunt. The VP shunt essentially consists of the following parts – ventricular catheter, valve, reservoir and distal catheter [Figure 1].

Indications of ventriculo-peritoneal shunt

VP shunt insertion is done to relieve hydrocephalus and its accompanying symptoms. Hydrocephalus can be caused due to a variety of causes including congenital (e.g., aqueductal stenosis, Dandy–Walker syndrome, Arnold–Chiari malformation, etc.), as well as acquired causes (e.g., meningitis, intracranial haemorrhage, brain tumours etc.).

Pathophysiology

Hydrocephalus is an abnormal accumulation of CSF inside the ventricles of brain. The three constituents of cranial cavity are brain tissue, CSF and blood. According to the Monro–Kellie doctrine, increase in the volume of any one of the cranial contents needs to be compensated by a decrease in other contents for intracranial cranial pressure (ICP) to be normal. In young children, however, the bony sutures are not ossified and the volume of cerebral vault can increase to compensate for increase in CSF volume during the initial stages. Any increase in the CSF volume beyond the compensatory values leads to raised ICP. Raised ICP manifests as headache, nausea, irritability and Cushing's syndrome. In children, additional findings are increased head circumference, bulging fontanelle and downward gaze of eyes (Sunset sign).

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Intracranial physiology

One must know the intracranial physiology to be able to make right decisions intraoperatively regarding anaesthetic management of these patients. Cranial cavity consists of brain, CSF and blood. Any increase in the volume of any of these three components causes increase in intracranial pressure after exhaustion of compensatory mechanisms (Monro–Kellie Doctrine). This increase in ICP leads to brain injury and hence needs to be minimized. Table 1 demonstrates the effects of various anaesthetic agents on Cerebral Blood Flow (CBF), Cerebral Metabolic Rate (CMR), Intracranial Pressure (ICP).

Hence, it follows that ketamine should preferably be avoided for induction. Among inhalational agents, sevoflurane and desflurane are better choices than halothane.

Anaesthesia management

Anaesthesia management for VP shunt insertion provides specific challenges. Some of these challenges are:

a. Airway management in small patients with large heads because of hydrocephalus [Figure 2]
b. Maintaining adequate cerebral perfusion and preventing increase in ICP during the surgery, especially during periods of stimulation such as intubation and tunnelling of shunt

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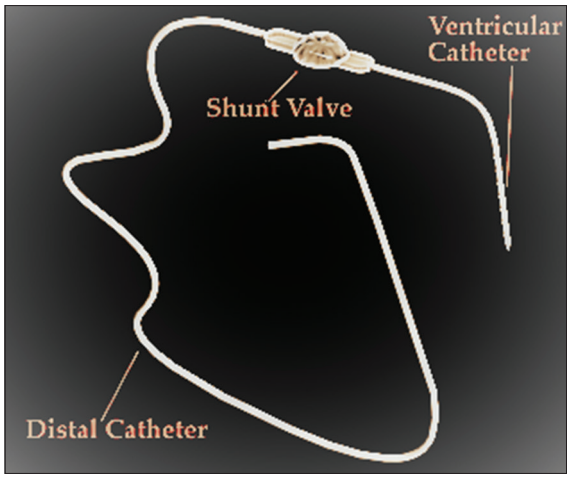

Figure 1: Parts of Ventriculo-peritoneal shunt

Figure 2: A neonate with hydrocephalus, possibly a difficult intubation. Also note the placement of ECG electrodes away from the site of tunnelling of shunt

Table 1: Effects of Anaesthetic agents on cerebral haemodynamics

Agent	Cerebral Bld. flow	Cerebral Met. rate	Intracranial pressure
Halothane	Marked increase	Decrease	Increase
Isoflurane	Increase	Decrease	No change/ Increase
Sevoflurane	Decrease/No change	Decrease	No change/ Increase
Barbiturates	Decrease	Decrease	Decrease
Propofol	Decrease	Decrease	Decrease
Ketamine	Increase	No change/ Increase	Increase

c. Selection of anaesthetic agents which prevents increases in ICP while also allowing rapid emergence.

Pre-anaesthetic check-up

In addition to the usual components of PAC (in-depth history, airway examination and cardiorespiratory evaluation), one should take into account the comorbidities of the patient and clinical assessment of the evidence of ICP elevation.

Induction of anaesthesia

Standard monitoring suffices for most patients except for those with co-morbidities. One should be careful to place ECG electrodes in such positions on the chest that they do not impinge on the proposed site of shunt tunnelling. The goals are prevention of hypotension and rise in ICP. Paediatric patients without an intravenous access can be induced using inhalational agents, whereas intravenous agents can be used in others. Except for ketamine, all intravenous induction agents can be used. Rapid sequence induction should be used for patients with raised ICP. Succinylcholine can be used for muscle relaxation if the risk of aspiration outweighs the problems of transient increases in ICP, otherwise nondepolarizing Neuromuscular blockers (NMB) are preferable. Intubation can prove to be challenging in patients with increased head circumference. In these cases, the patients can be intubated with their heads pulled beyond the head end of the operating table and supported by an assistant. Intubation in lateral position can also be tried in these patients. The endotracheal tube should be firmly fixed. Eyes should be taped shut.

Positioning

The patients are kept supine with the head rotated to the opposite side. Adequate padding of the eyes is important. One should be aware of possible endotracheal tube migration while the patient is positioned for surgery. A roll of towel is placed below the shoulders to facilitate tunnelling for distal catheters.

Maintenance of anaesthesia

A balanced technique of anaesthesia is usually advised, involving NDMRs, inhalational agents (up to 1.5 MAC) and opioids. Nitrous oxide increases cerebral blood flow and is therefore not recommended. An increased depth of anaesthesia or administration of short acting opioids is advised during initial incision and tunnelling for distal catheter to attenuate increase in heart rate and ICP. Prevention of hypothermia is important, especially in paediatric patients. One should be cautious of abrupt fall in blood pressure on cannulating the ventricle due to sudden release of brain stem pressure. Intraoperative prevention of hypothermia is of utmost importance.

Postoperative considerations

Most patients with an uneventful surgery can be extubated, except for patients with a poor pre-op neurological status. Premature infants should be observed for postoperative apnoea. Local anaesthetic infiltration can be employed for post operative pain control along with paracetamol, NSAIDS and opioids (under observation).

Postoperative malfunctions and complications

The malfunction of VP shunts postoperatively can be because of breakage, obstruction, migration or disconnection. Infection of shunt manifests as fever, meningeal signs, presence of

purulent material around the shunt insertion site and redness along the shunt tract. Over drainage of CSF from shunt can cause subdural haematoma. VP shunts predispose to the development of inguinal hernia. Many of these patients need to be taken up for shunt revision.

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Conflicts of interest

There are no conflicts of interest.