Anesthesia for Endoscopic Third Ventriculostomy

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13.1 Introduction

Endoscopic third ventriculostomy (ETV) is one of the most recent advances in the treatment of obstructive hydrocephalus. Subsequently there have been a number of publications which have established its role in neurosurgical practice, particularly in hydrocephalus. ETV is a standard surgical procedure for treatment of non-communicating hydrocephalus. This procedure requires a general anesthetic and necessitates manipulation of the brain neural structures to access the floor of the third ventricle. In this chapter we are going to focus on ETV sciences in terms of history of ventriculoscopy, endoscopic ventricular anatomy of the third ventricle, surgical technique, and anesthetic considerations of ETV.

13.2 History of Ventriculoscopy

In the early 1900s, Walter E. Dandy was one of the first surgeons to use a primitive endoscope to perform choroid plexectomy in a patient with communicating hydrocephalus [1]. The first ETV was performed by William Mixter, a urologist, in 1923. Mixter used a urethroscope to examine and perform the ETV in a child with obstructive hydrocephalus [2]. Putnam then borrowed this urethroscope and optimized its use for the ventricular system. His ventriculoscope was specifically designed for cauterization of the choroid plexus in children with hydrocephalus [3]. Nevertheless, the arrival of valve-regulated shunt systems and the simplicity of the technique resulted in minimal advances in ETV for 30 rs. In 1947, McNickle introduced a percutaneous method of performing ETV that decreased the complication rate and improved the success rate [4]. There has since been renewed interest in the use of ETV for the treatment of obstructive hydrocephalus. This has been related to advanced fiberoptic and lens technology. There are now small neuroendoscopes available that have deflectable tips, working ports, and good optic resolution, in addition to the rigid endoscopes with their excellent optic resolution. In recent series of ETV performed for the treatment of obstructive hydrocephalus, success rates between 50% and 94% have been reported [5]. Improvements in the technique will surely come as more clinicians perform ETV and communicate their experiences.

13.3 Endoscopic Ventricular Anatomy

It is important to be familiar with the ventricular anatomy. The foramen of Monro is the first structure visualized. The foramina are paired structures serving to connect the lateral ventricle with

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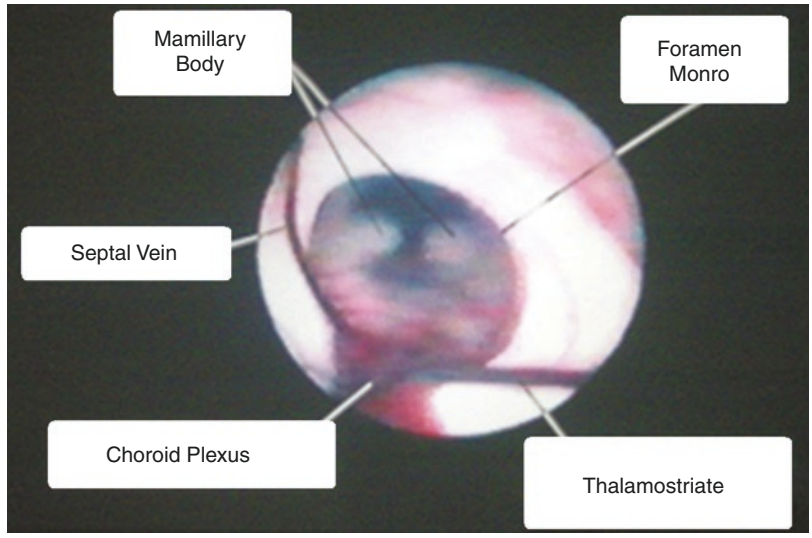

Fig. 13.1 Endoscopic anatomy of the foramen of Monro (live case from our setting)

the third ventricle. The head of the caudate is situated laterally and the septum pellucidum is located medially. The choroid plexus of the lateral ventricle projects forward to the foramen, through which it passes before turning posteriorly to lie under the roof of the third ventricle. The vein of septum pellucidum, located anteromedially, joins the thalamostriate vein, located posterolaterally, at the posterior rim of the foramen of Monro. These vessels join and ultimately form the internal cerebral vein, which runs in the tela choroidea of the third ventricle (Fig. 13.1).

These veins should become larger in caliber as they approach the foramen of Monro. The fornix is intimately related to the foramen. The C-shaped fornices are paired, efferent-output bundles projecting from the hippocampus to the mammillary bodies, passing from the medial margin of the foramen anteriorly before diving into the medial wall of the third ventricle. Inside the third ventricle, there are several anatomical landmarks. Two hypothalamic mammillary bodies are intersected by the basilar artery and most anteriorly the pituitary infundibulum (Fig. 13.2). The lateral walls consist of the anterior two thirds of the thalamus and hypothalamus, continuous with the gray matter of the floor. The lateral walls are joined by a band of gray matter, the massa intermedia. The posterior border consists of the pineal body, the habenular commissure, the posterior commissure, and the cerebral aqueduct. The aqueduct is a narrow channel approximately 15 mm long and 1 mm wide that connects the third ventricle with the fourth ventricle. A clear view of the floor of the third ventricle is provided once the endoscope is passed through the foramen of Monro. The floor is formed mainly by hypothalamic nuclei. In an anteroposterior direction, these are the optic recess, the optic chiasm, the infundibulum, the infundibular recess, the tuber cinereum, and the mammillary bodies. In the majority of cases,

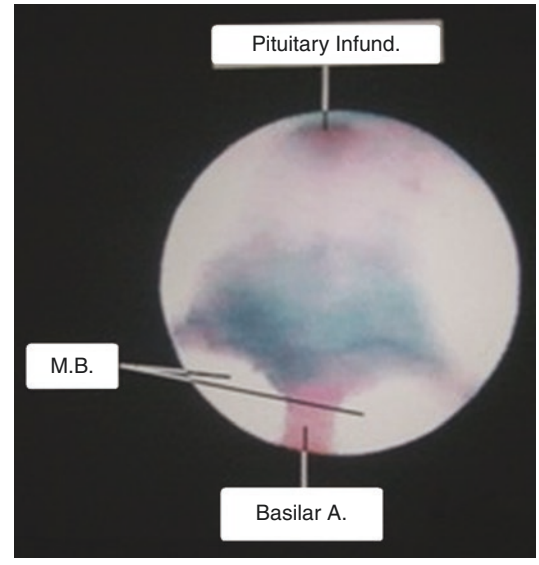

Fig. 13.2 Floor of the third ventricle (live case from our setting). *MB* mammillary bodies

the floor (tuber cinereum) of the third ventricle is often thinned out and translucent.

13.4 Surgical Technique and Technical Considerations

The scope is introduced through the anterior fontanelle or a burr hole (according to the patient age) just anterior to the coronal suture in the midpapillary line. The scope then passes from the lateral ventricle through the foramen of Monro toward the floor of the third ventricle. The floor of the third ventricle is punctured posterior to the infundibular recess with the tip of the scope. The fenestration is enlarged slightly with gentle movement of the tip of the scope and passed through the hole. Irrigation with saline at body temperature at different rates as required is used for the clarity of the field only if hemorrhage occurs. The cerebrospinal fluid was then allowed to drain into the basal cistern, bypassing the aqueduct stenosis to the surface of the brain (Fig. 13.3) [6]. Jallo et al described his technique using different tools as follows: after general anesthesia is induced, the patient is placed supine with the head in the neutral position on a doughnut pillow. The head is then elevated approximately 30°. The coronal burr hole 3 cm lateral to midline, 6–10 mm in diameter, is created on the side of the normal foramen of Monro, larger lateral ventricle, or right side. The dura mater is then opened in a cruciate fashion, and a No. 14 French peel-away catheter is then used to cannulate the lateral ventricle. The stylet is then removed to ensure the proper placement into the ventricular system, and the two leaves are peeled away and stapled to the drapes. This maneuver prevents inadvertent passage of the sheath deep into the ventricles. The advantages of this sheath include an egress pathway for irrigation fluid or CSF and repeated passage of the endoscope without traction on or injury to the brain. The foramen of Monro is at mean distance of 6 cm from the dura mater via this coronal approach in an adult and less than that in children. The endoscope is passed through the sheath and the lateral ventricle is visualized. The foramen of Monro is identified, and the scope is navigated into the third ventricle. The floor of the third ventricle is, on average, 9 cm from the dura mater, but this is highly variable depending on age and extent of hydrocephalus. The mammillary bodies and infundibular recess are identified in the attenuated floor. It is often possible to see the basilar artery through the diaphanous floor of the third ventricle. At this juncture, the surgeon should be certain that the intended fenestration will be anterior to the BA. It is wise to have confirmed this on the sagittal MR image obtained before surgery. A Bugbee wire, without electrocoagulation, is used bluntly to puncture the floor of the third ventricle midway between the mammillary bodies and the infundibular recess. The Bugbee wire is then removed, a No. 3 French Fogarty balloon catheter is advanced through the opening in the floor, and 0.2 ml of fluid is instilled into the balloon, inflating it, to widen the newly created aperture. This maneuver widens the fenestration to a width of approximately 5 mm. We do not inflate the balloon under the floor and pull back through the stoma. The scope is then carefully guided into the prepontine cistern. Any arachnoid bands or imperforate membrane of Liliequist that seem to be impeding the free flow of CSF are bluntly disrupted with the Fogarty catheter. After the stoma is created, the to-and-fro oscillations of the ventricular floor indicate good CSF communication

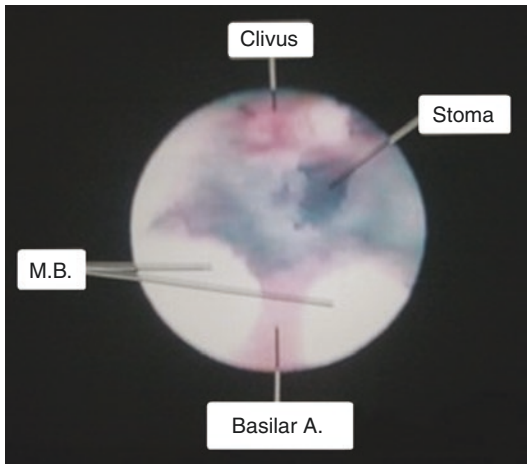

Fig. 13.3 Fenestration stoma in the floor of the third ventricle (live case from our setting)

between the ventricles and subarachnoid space. Besides Bugbee wire other methods to create the fenestration include using the endoscope as a blunt trocar and using laser, bipolar, and monopolar instruments. Doppler devices are available that can help locate the basilar artery prior to the thermal fenestration. At completion of the fenestration, the endoscope and sheath are removed, Gelfoam is placed in the burr hole, and the scalp is sutured. The galea is closed with a Vicryl suture and the skin with surgical staples. If any bleeding has occurred, a ventricular drain is commonly left in place for 1–2 days. A ventricular drain is left in place in patients who have previously undergone shunt insertion. In these patients, the shunt system will be observed for several days [7].

13.5 Indications of Neuroendoscopy

ETV is ideal for candidates with an obstructive etiology due to a variety of possible causes, including primary congenital anomalies such as aqueductal stenosis, myelomeningocele, and idiopathic causes [8–10]; obstruction secondary to pineal region tumors for which ETV and biopsy may be coupled [11–13]; aqueductal stenosis secondary to tectal gliomas [14]; and giant retrocerebellar cysts [15]. Some have found ETV to be effective in managing hydrocephalus in children with posterior fossa tumors prior to tumor resection [16, 17]. ETV also provides great utility in managing patients with obstructive hydrocephalus who present with shunt failure secondary to obstruction, infection, abdominal CSF pseudocyst, or other complications [18, 19]. In cases where shunting can give rise to slit ventricle syndrome, ETV has also been proven effective in assessing brain compliance. Specifically, if the brain is sufficiently compliant, the existing shunt is removed, and ETV is performed during the same operation [20]. Preformed cavities filled with crystal-clear CSF, such as the ventricular system, subarachnoid space, and some cystic lesions, provide most favorable conditions for the application of endoscopes. Therefore, hydrocephalus, intraventricular lesions, and space-occupying arachnoid or parenchymal cysts are perfect indications for the use of an endoscopic approach. Due to the further improvement of endoscopic hemostasis even highly vascularized tumors can be resected. Management of hydrocephalus represents the classic indication for a neuroendoscopic approach. Currently, hydrocephalus remains the most frequent intracranial disease treated endoscopically. ETV has become a well-established procedure for the treatment of non-communicating hydrocephalus. ETV has been successful in controlling obstructive hydrocephalus caused by tumors, aqueductal stenosis, hemorrhages, and infarctions. Although the procedure is commonly considered to be safe and straightforward, severe and, rarely, fatal complications may occur. One of those complications, namely, acute respiratory failure, happened in our setting. The authors report an 8-month-old patient with obstructive hydrocephalus secondary to posterior fossa cyst and Chiari malformation. After ETV he developed difficulty in breathing, and the trachea had to be reintubated and ventilated. The infant recovered fully after craniocervical decompression and insertion of cystoperitoneal shunt. We speculate that respiratory failure is related to relative expansion of the posterior fossa arachnoid cyst, causing significant compression on the brain stem. Supportive care with mechanical ventilation and brain stem decompression were the mainstay of treatment [21]. In our setting and in a larger study on 52 children younger than 1 year who underwent ETV for treatment of hydrocephalus. The overall success rate was 69.4% with mean follow-up period of 68.2 months. Patients with aqueduct stenosis had a higher success rate of ETV which was 77.4%. Seven infants were born preterm, six of them required a permanent VPS; $p = 0.003$. There was one death from intracranial hemorrhage, two cerebrospinal fluid leaks, and one meningitis [22]. We concluded from this study that ETV can be considered a possible treatment procedure alternative to VPS for the treatment of occlusive hydrocephalus in infants. ETV was effective in full-term infants, while the results in low-birth-weight, preterm infants were poor. Success of ETV is not only age dependent but also etiology dependent.

Infants with occlusive hydrocephalus treated with VPS, who present with shunt failure, could be treated by ETV and removal of the shunt device. The correct placement of the fenestration in the floor of the third ventricle is of utmost importance to avoid vascular and neural damage. The perforation of the floor should be made halfway between the infundibular recess and mammillary bodies in the midline, just behind the dorsum sellae. In this way, hypothalamic injury, oculomotor palsy, and vascular injury are unlikely to occur. Careful inspection of a CT scan or sagittal MR image to assess the individual relation of the basilar artery and the floor of the third ventricle is advisable.

13.6 Anesthetic Considerations

13.6.1 Preoperative Evaluation and Premedication

The evaluation must include history and physical examination pertaining to the conditions requiring special anesthetic considerations. Patient's neurological status is noted before accepting the case. Associated bulbar palsy and sleep disturbance are also noted. Assessment of neurological status should include evidence of raised intracranial pressure (ICP), altered sensorium, and cranial nerve palsies. Infants with ICP might present with irritability, lethargy, decreased consciousness, failure to feed, bulging fontanel, and cranial enlargement [23]. In children, it may present with early morning headache, vomiting without nausea, diplopia, and papilledema and, in late stage, with Cushing's triad. Frequent vomiting episodes may lead to dehydration and electrolyte imbalances and increase the risk of aspiration. Hence, serum electrolytes should be determined to identify abnormalities of sodium and potassium following vomiting. Dehydration and electrolyte abnormalities if present need to be corrected before surgery. Other laboratory investigations should include hemoglobin or hematocrit level and typing and crossmatching of blood if the loss is expected to be considerable. Additional studies should include electrocardiogram (ECG), coagulation profile, and renal and hepatic function, as deemed necessary. Patients are at higher risk of urinary tract infections or impaired renal function as a part of multisystem congenital syndromes. In our setting, patients with depressed mental status received no premedication. Otherwise, trimeprazine syrup 0.5 ml/kg b.w. 30 min preoperatively was given to children less than 2 years. Older children receive oral midazolam 0.5 mg/kg b.w. 30 min preoperatively.

13.6.2 Pediatric vs. Adult Airway

The key principle to understand about the pediatric vs. adult airway is that it is smaller in diameter and shorter in length than the adult's. That airway resistance is primarily influenced by the diameter of the airway, and resistance can be dramatically increased with subtle changes (such as soft tissue swelling) in an already small system. It should be noted also that children younger than 10 have the narrowest portion of the airway below the glottis at the level of the cricoid cartilage. This is why uncuffed endotracheal tube is preferred in pediatric vs. adult airways. A cuffed tube during a prolonged intubation can increase soft tissue swelling, and again this can decrease the radius and narrow the airway significantly increasing resistance; a clinical example of this is a child with stridor. In a patient with stridor, the airway is swollen to the point that air being drawn past the narrowing makes an audible sound. The larynx in infants and young children is located more anteriorly making it potentially more difficult to obtain a complete view during laryngoscopy. The epiglottis in infants and young children is relatively long, floppy, and narrow, and it can be difficult to navigate your laryngoscope around it. Children with large occiput and large tongue will lead to upper airway obstruction especially during times of apnea or hypoventilation. These factors are often relieved by placing a properly sized oral airway device and gently manipulating the head of the patient to achieve the proper sniffing position (Fig. 13.4). We had a hydrocephalic child poster to undergo ETV with cleft lip and palate

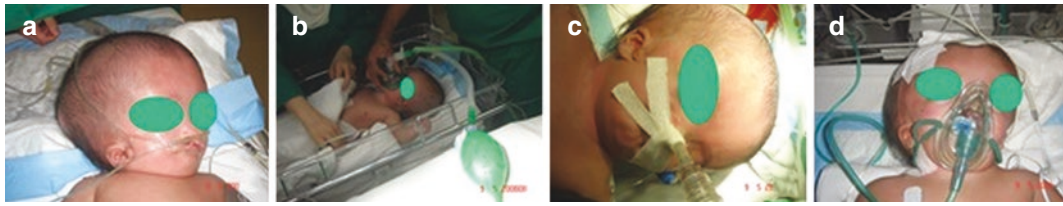

Fig. 13.4 A hydrocephalic patient with laryngeal mask airway (LMA). (**a**) Before induction. (**b**) At induction. (**c**) LMA inserted. (**d**) At recovery

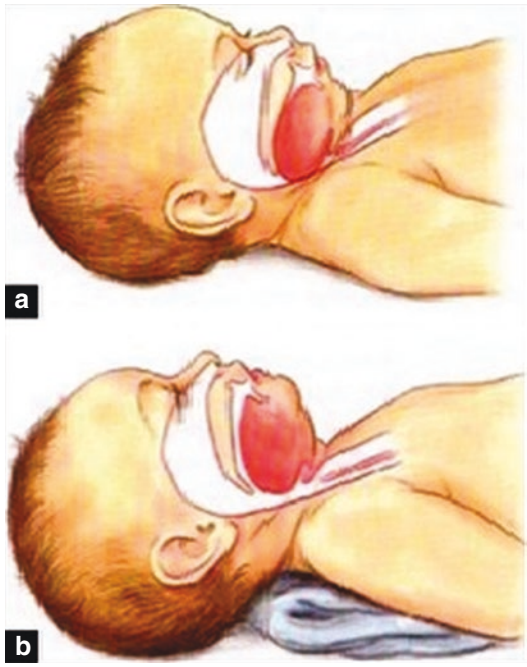

Fig. 13.5 (**a**) Head position. (**b**) Corrected head position

where laryngeal mask airway (LMA) is the only preferred choice used to maintain the airway intraoperatively (Fig. 13.5). Children and neonates are also prone to faster rapid oxygen desaturation. The pediatric vs. adult airway has a higher metabolic rate, increased closing volumes, and higher minute ventilation to functional residual capacity ratios all contributing to a more rapid desaturation. The infant diaphragm is the major muscle of ventilation and fatigues much easier than the adult airway during times of distress. The pliable rib cage of infants and children diminishes the efficacy of infant's attempts to increase ventilation. Sedative and narcotic premedication should be avoided in all the children suspected of increased ICP as these medications decrease respiratory drive which may result in hypercapnia and further increase in ICP [24]. However, patients with normal ICP, such as those scheduled for repair of vascular lesions, may be sedated so as to allay preoperative anxiety and avoid hypertension, thus preventing rupture of vascular abnormality. Oral benzodiazepines (midazolam) may be beneficial for small children as they provide sedation without respiratory depression and should be administered under supervision [25].

13.6.3 Induction and Maintenance of Anesthesia

The goal of anesthetic induction is to avoid increase in ICP owing to associated hypoxia, hypercapnia, and volatile anesthetic-induced increases in CBF. An intravenous (IV) induction with propofol and neuromuscular block to facilitate endotracheal intubation is best in children with raised ICP. However, in children without IV access, inhalational induction by face mask with sevoflurane should be preferred as crying or struggling may lead to further increase in ICP. After the IV access is secured, the inhalational technique may subsequently be changed to an IV induction. All volatile anesthetics cause an increase in CBF and thence the ICP. Therefore, ventilation should be controlled as early as possible and mild hyperventilation be instituted to prevent rise in ICP. Children at risk for aspiration should undergo rapid-sequence anesthetic induction with thiopentone or propofol followed by rapid-acting muscle relaxants such as suxamethonium or rocuronium. Maintenance of anesthesia is achieved with

inhalation anesthetic sevoflurane in 50% air in oxygen for all patients. Analgesia is achieved with 1 mcg/kg of fentanyl, and muscle relaxation maintained with incremental doses of rocuronium when required. At the end of surgery, IV reversal agents for muscle relaxants were given in usual doses (atropine 20 mcg/kg and neostigmine 80 mcg/kg), and the trachea is extubated. Patients then were sent to the recovery room and later to the ward [26]. Large exchange of irrigation fluid and wetting of surgical drapes expose the child to the risk of life-threatening perioperative hypothermia. The use of thermal blanket and warm irrigation fluids or fluid warmer is strongly advocated. The largest possible catheter should be used to establish peripheral venous line, and access should be ensured throughout the procedure. The aim of IV fluid administration is to maintain normovolemia. In general, there is no requirement for blood transfusions. Routine and emergency drugs must be labeled and kept. Eyes should be protected from external pressure and surgical cleaning solutions. While positioning the child, care must be taken to ensure adequate ventilation and avoidance of venous congestion.

13.6.4 Intraoperative Monitoring

A consensus on standard monitoring requirements has not yet established in the literature. Basic monitoring includes electrocardiography, pulse oximetry, capnography, temperature, and urine output monitoring. In our setting and due to the hemodynamic changes occurring during the procedure, we use to increase the tone of the ECG monitor to be audible to both the surgeon and the anesthesiologists for early recognition and diagnosis of any changes and prompt management without delay. There are many authors who recommend invasive blood pressure monitoring by indwelling arterial catheter in all patients, irrespective of their age [27]. In our setting we don't recommend insertion of arterial cannula. Abrupt changes in CBF due to changes in ICP are possible during the procedure. Transcranial Doppler is the fastest and most reliable method to detect any fluctuations in CBF due to changes in ICP [28]. It has got high sensitivity to changes in CBF. However, practical objections restrict it as a routine use in neuroendoscopic procedures even though many consider it as a routine monitor in neuroendoscopy. The use of ICP monitoring and the methods employed is another debatable point. Even though several strategies to ICP monitoring are described, measuring through the rinsing channel of the endoscope is preferred in literature. In one of our studies, we have used intraoperative ICP monitoring intraoperatively, but currently we are not using it as a routine. Although the experimental animal models favorably suggested the use of mild hypothermia in neurosurgical patients, it has not been extrapolated to humans. The intraoperative goal is to maintain normothermia and avoid both hypothermia and hyperthermia with application of different methods.

13.6.5 Fluid Management

Warmed Ringer's lactate or normal saline is used for irrigation during ETV. Normal saline is the most commonly administered crystalloid during pediatric neurosurgical procedures as it is mildly hyperosmolar and hence prevents cerebral edema [29]. However, infusion of large quantities (>60 ml/kg) of normal saline may cause hyperchloremic metabolic acidosis and hypernatremia [30]. Ringer's lactate is slightly hypo-osmolar and may increase cerebral edema if infused in large quantities. Hyperglycemia worsens reperfusion injury, and so glucose-containing fluids should not be used during these procedures. However, in neonates and premature infants, the danger of hypoglycemia should be borne in mind. Blood glucose should be closely monitored in these patients, along with continuous infusion of glucose at 5–6 mg/kg/min [31, 32]. Children do not need exogenous glucose administration and are able to maintain normal levels along with the associated surgical stress. Blood transfusion should be guided by the degree of blood loss and initial hematocrit values.

13.6.6 Complications

ETV is the method of choice in the treatment of obstructive hydrocephalus [33]. The reported complications of ETV include hemiparesis [34] and transient third cranial nerve paresis [35]. At the same time, patients might develop transient fever because of aseptic irritation of the ependyma or manipulation of the hypothalamus [33]. Life-threatening complications such as hemorrhage from traumatic basilar artery aneurysm and cardiac arrest have also been reported [36, 37]. Experimentally, the stimulation of the hypothalamic nuclei can cause a variety of sympathetic and parasympathetic responses [38, 39]. In an attempt to identify the possible mechanisms of the hemodynamic changes, namely, bradycardia during ETV under anesthesia, we compared the intracranial pressure and the hemodynamic changes with negative correlation [40]. Manipulation of delicate structures around the third ventricle (hypothalamus and brain stem) can occasionally lead to intraoperative bradyarrhythmias, hypotension, hypertension, and even cardiac arrest [41]. In one of our study series on complications of ETV and its effect on hemodynamics on 49 pediatric patients, bradyarrhythmia was reported in 20 patients (41%), which warranted the surgeon to temporarily stop the procedure. Withdrawing the scope away from the floor of the third ventricle successfully resolved the bradycardia. However, once the heart rate was stabilized and the floor of the third ventricle was perforated, the bradycardia resolved immediately. None of the patients required atropine [6]. Fabregas et al. reported 1% mortality rate among 100 neuroendoscopy cases. Also they reported intraoperative complications in 36 patients with arterial hypertension being the most frequent (53%) and postoperative complications in 52 patients, anisocoria (31 %) and delayed arousal (29%) [42]. Intraoperative hemodynamic changes during ETV have been extensively studied with conflicting results. In one study tachycardia was found more frequently than bradycardia and was attributed to an increase in ICP and systemic hypertension and was caused by high-speed fluid irrigation or kinking of the outflow tube [41]. Atypical Cushing response was given to explain the frequency of tachycardia during ETV. The classic response as described by Cushing includes apnea, hypertension, and bradycardia. However, in the literature, tachycardia consistently preceded bradycardia in the Cushing response and was attributed to compression of the hypothalamus by dilated third ventricle [43, 44]. Baykan et al. reported bradycardia intraoperatively alone in 28.1% and the respective rates for asystole and for bradycardia following tachycardia as 0.5% and 12.4% with an overall incidence of arrhythmia involving bradycardia as 41% [45]. Derbent et al. encountered bradycardia in only 1 of the 24 patients for a short period during balloon inflation with possible temporary brain stem ischemia and subsequent bradycardia [46]. Fatal complications described in the literature are rare. However, injury of the basilar artery is the most feared intraoperative complication. This can lead to massive intraventricular and subarachnoid hemorrhage, hemiparesis, and midbrain damage. Other reported neurological complications are paralysis of III and VI nerves, delayed awakening, transitory mental confusion, headache, loss of memory, infection, convulsions, and pneumocephalus [47]. In a retrospective study on 223 adult and pediatric patients, the reported complications were hypothermia (25.1%), and cardiovascular complications (such as tachycardia 18.8%, bradycardia 11.3%, hypertension 16.1%, and hypotension 16.6%) were the commonly observed complications during intraoperative period both in pediatric and adult patients. At the end of the procedure, delayed arousal was observed in 17 patients and 19 patients requiring postoperative ventilatory support. Postoperative frequent complications included fever (34.1%), tachycardia (32.7%), and nausea and vomiting (18.8%). Potentially fatal complications such as intraoperative hemorrhage, air embolism, etc. were rare. Most of the complications were transient and self-limiting [48]. Hypothermia is a potential complication that can result in delayed awakening and disordered coagulation. However, some of the commonly observed postoperative complications

such as vomiting and respiratory problems are not specific to the procedure. Overall, a good long-term outcome after ETV is between 70% and 80% in most case series [49]. Another issue of interest following ETV is the postoperative electrolyte imbalance. Postoperative hyperkalemia has been reported following ETV [50]. The authors attributed hyperkalemia to a disturbance related to the hypothalamic nuclei situated in the floor of the third ventricle. However, the hyperkalemic response in these patients has been noticed in isolation, without any change in the serum sodium level. Also it was transient and late in onset which suggests a hormonal dysfunction. In that report we found that the authors were using lactated ringer solution for irrigation, which we believe has contributed to the hyperkalemic response following ETV. Derbent et al. reported in their study that although they were using lactated ringer solution for irrigation and 0.9% normal saline for intravenous fluid replacement during ETV, there was no significant difference between the pre- and postoperative serum sodium and potassium [46]. In our setup we are using normal saline and not lactated ringer for irrigation, and in spite of that, we have reported hypokalemia and hypernatremia in the second and third postoperative days following ETV with no clinical significance [51].

13.7 Conclusions

We conclude that ETV has become the most common procedure for treatment of obstructive hydrocephalus. With improvements in technology, neuroendoscopy in pediatric population is now routinely performed in more centers. Anesthesiologists should be aware of the intra- and postoperative complications secondary to ETV. Intraoperative bradycardia is the commonest arrhythmia that occurs during the procedure. Precautions like alerting the surgeon and pulling out the scope away from the floor of the third ventricle are enough procedures to revert bradycardia if it occurs. Any fluid and electrolyte abnormalities should be corrected before taking up for procedure. Attention should be given to problems specific to pediatric age group such as hypothermia and fluid overload. Though postoperative electrolyte imbalance occurs, we believe it has no clinical significance. We believe that either normal saline or lactated ringer solutions could be safely used for intraoperative irrigation with minimal postoperative clinical impact. Though it is a minimally invasive procedure, close observations of vital signs, serum electrolytes, as well as volume and temperature of the irrigation fluid besides close communication between anesthesiologist and surgeon are important precautions for better outcome.

Key Points

- Endoscopic third ventriculostomy is the surgical treatment of choice for obstructive hydrocephalus.
- Understanding the anatomy of the third ventricle floor is important to manage the intraoperative complications.
- General anesthesia is indicated for endoscopic third ventriculostomy.
- The most often reported intraoperative complication is bradycardia which occurs during the fenestration of the third ventricle floor.
- Alerting the surgeon and withdrawal of the endoscope are the preferred precautions to revert bradycardia.

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