CHAPTER 29

Complications of Endoscopic Third Ventriculostomy

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Introduction

Justifiably, endoscopic third ventriculostomy (ETV) is considered the greatest breakthrough in the management of hydrocephalus since the introduction of Silastic shunts. Among selected patients, the procedure can render over 70% of children shunt-independent [13, 27, 28]. More recently, however, the procedure has been the focus of scrutiny, with an increased number of reports showing long-term failures and serious complications [1, 4, 8, 11, 16, 17, 23, 25]. Indeed, it is felt among the endoscopic neurosurgical community that the real complication rate may be higher than those published. Although this chapter will review both the well-known and the rarer complications of ETV, complication avoidance will constitute the main body of the text.

Complications Specific to ETV

Bradycardia and Asystole

This common intraoperative complication has been recognized for many years [7, 12]. It was documented in one of the first large series of ETV [27] and identified as a not uncommon occurrence that should be anticipated and detected by turning up the volume of the cardiac monitor. It can occur at any time during manipulation of the third ventricle. It may occur when the scope is introduced, when irrigation is used, or when pressure is placed on the floor (Fig. 1) [2]. The bradycardia resolves with removal of the scope from the third ventricle, removal of irrigant if there is obstruction of outflow, and with release of pressure from the floor. If the bradycardia is not recognized, it will invariably progress to asystole and possible hemodynamic compromise. Handler et al. reported such an occurrence, which fortunately had no long-term adverse consequences [12].

Avoidance

There are several theories behind the genesis of this problem. Among them is the possibility that the scope obstructs both foramina of Monro, resulting in high pressure within the third ventricle when irrigant cannot escape. Another is that the irrigation fluid is either too different to CSF in osmolality or too cold, resulting in irritation of the hypothalamus. Finally, it may be a pure traction phenomenon of either the floor or walls of the third ventricle and hence hypothalamic dysfunction (Fig. 1). Whatever the theory you subscribe to, it would be prudent to obey the following rules:

1. Always check to see that there is an adequate outflow mechanism for the irrigant. Simply having
one of the working channels open does not guarantee egress of fluid. It is not uncommon for a piece of brain or blood clot to obstruct one of these small working/irrigation channels at any time throughout the procedure.

2. Turn up the volume of the cardiac monitor and keep the noise down in the operating room. If the pulse slows, discontinue whatever you happen to be doing, and if possible, reverse the last action.

3. Use isotonic solution, preferably lactated Ringer’s, as your irrigant of choice. The fluid should be warmed to approximately body temperature.

4. When puncturing the floor, be sure to use a sharper technique if the floor is thick and nonattenuated (Fig. 1).

Fig. 2. Postoperative CT of a child who had an ETV complicated by intraoperative hemorrhage. It occurred at the time of the ventriculocisternostomy

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Visual Obscuration

There are several causes for a less than optimal view. Of course, the system should be checked before the dura is opened to ensure all components of the video chain are operational. The view can be hindered by fogging of the lenses at any junction, by damaged hardware, and by incorrect assembly of all the different components. The most common cause, however, is intraventricular hemorrhage (Fig. 2). This can occur at any time during the procedure, but usually happens when the ependyma is breached as the scope enters the ventricle for the first time. The bleeding can be minor or quite profuse. It is rarely arterial except when small vessels are torn as the stoma is created. Excessively wide excursions of the scope will increase the chances of bleeding. It is surprising how the spilling of such a small amount of blood may result in such a dramatic effect on visualization. The most important point to remember is not to panic, irrigate generously, and maintain access to the ventricle. Once vision is obscured, try to place the end of the scope in the largest cavity. For example, if hemorrhage occurs when the scope is in the third ventricle, the loss in vision may cause the operator to move the scope only a fraction of a centimeter, which could have drastic consequences. A similar movement in the larger lateral ventricle might not have any adverse result. Once hemorrhage occurs and irrigation is proving unsuccessful, there are several other techniques that can be employed. The scope itself can be placed against the bleeding vessel to tamponade the flow. Of course, one must first identify the responsible vessel, which may prove difficult given the bloody CSF and visual impairment. The next technique is to try and coagulate the vessel with either monopolar or bipolar endoscopic forceps. In reality this maneuver is very difficult. Endoscopic instruments are not readily steerable and the vessel is often floating around in the CSF, creating a moving target with the copious irrigation. If all else fails, CSF can be removed from the ventricle and replaced with air, thereby allowing the surgeon to use standard coagulating techniques without visual obscuration. It is very important to replace the CSF with air to prevent the ventricles from collapsing, as this can create an even worse set of complications.

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Avoidance

Prevention of hemorrhage is clearly the optimal way to manage this dilemma:

1. Tap the ventricle with a smaller brain needle before passing the larger sheath. This will give the sheath easier access and, hopefully, less traction on the ventricular walls.

2. Maintain your trajectory. Try not to move the scope from side to side. A small degree of movement may tear the ependymal vessels.

3. When using a rigid scope, make sure the edges are blunt and rounded. Sharp edges tend to damage vessels (Fig. 3).

4. When using a flexible scope, check that the scope is in the neutral position before removing it.

5. If you are using a technique that requires you to remove and replace scopes into the ventricle it would be wise to use a peel-away sheath in order to maintain a tract through the brain (Fig. 4).