Editorial

Current perioperative management of cerebrospinal fluid drains

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Preventing spinal cord ischemic (SCI) requires a multidisciplinary strategy. Cerebrospinal fluid drainage (CSFD) is an adjunct of spinal cord protection in distal aortic repairs.

In this editorial, we will discuss controlled CSFD and somatosensory/motor evoked potentials (SSEP/MEP) guided CSFD management and associated complications gleaned from our three decades of clinical experience.

In our practice, CSFD is placed at the day of surgery, after the induction and monitoring line placement (1). Intraoperative management of CSFD starts with recording the baseline intracranial pressure (ICP) with continuous monitoring of ICP with intermittent drainage of CSF. Before aortic cross clamping, if the ICP is below central venous pressure (CVP) or 10 mmHg, we do not drain CSF. If ICP is higher than CVP (or 10 mmHg), we remove 5–10 mL CSF every 30–60 minutes.

After the aortic cross clamping, we drain 5–10 mL CSF every 20–30 minutes to achieve lower ICP than CVP and ICP less than 10 mmHg. If neuromonitoring is indicative of SCI (i.e., MEP/SSEP signal loss), we aggressively open CSFD to reach the goal of ICP 5–10 mmHg while optimizing cardiac output, blood pressure, and hematocrit and correcting acidosis/alkalosis and electrolytic imbalance.

Our postoperative management of CSFD is dependent on the patient's neurological examination and intraoperative changes in neuromonitoring. Changes in intraoperative SSEP/MEP implies that the patient is at risk of SCI. When there are no intraoperative changes in MEP/SSEP—and no postoperative SCI—we manage CSFD with SCI preventive protocols. The CSFD is usually removed on postoperative day 3. However, when SCI occurs postoperatively, CSFD is the key therapeutic measure, with the goal to achieve a pressure of less than 5 mmHg, in addition to maintaining hemoglobin >10 g/dL, cardiac index >2.5 L/min/m^2 and systolic blood pressure of 140 mmHg [CSF drain status, Oxygen delivery, Patient Status (COPS) protocol]. We have found that delayed paraplegia can occur days after the surgery, which can be caused by postoperative hypotension, spinal cord edema, reperfusion injury, and intercostal artery thrombosis. The COPS protocol is initiated. The CSFD is kept in place for maximum of 7 days from the onset of SCI.

The most common perioperative complications related to CSFD are bloody CSF or malfunctioned CSFD system, non-clinically significant subdural hematoma, post-dural puncture headache (PDPH), and CSF leakage. Subdural hematoma or bloody CSF with neurologic changes and meningitis are rare but can be lethal. In this situation, magnetic resonance imaging (MRI) or computed tomography (CT) scan is required and consultation with neurosurgeons is warranted.

Strategies that control the volume and speed of CSFD simultaneously to increase spinal cord perfusion pressure is important in preventing hemorrhagic complications. Patients with cerebral atrophy are at increased risk of this complication. We often see bloody CSF when aggressive CSFD is required to achieve CSF pressure lower than 5–10 mmHg during the therapeutic CSFD period. Changes in intracranial pressure, not removed CSF volume, is directly associated with bloody CSFD. Cerebrospinal fluid can be removed, more than 200 mL over 24 hours, without issue if ICP is stable. However, we find that 10–20 mL of

CSFD can cause bloody CSF in some patients, especially in patients with brain atrophy. The changes in ICP should be closely monitored during CSFD and adjusted case by case.

Once bloody CSF is noted, we immediately stop CSFD. Serial neurological examinations are performed. We send coagulation studies and correct any abnormalities. In asymptomatic patients with negative CT/MRI studies, CSFD can be restarted after 4–6 hours, as needed, for spinal cord protection. The benefits of spinal cord protection vs. the increased risk of subdural hemorrhage are sometimes difficult to balance. Multidisciplinary discussion and individual case management are required.

Post-dural puncture headache commonly occurs in young patients, due to intracranial hypotension by reduced CSF volume or cerebral and meningeal vasodilation. Headache can accompany other neurological complications, including ocular and auditory problems. We prefer conservative treatment, including flat bedrest for 8–24 hours with oral or IV hydration. If CSF leak is present, we apply pressure dressing. Caffeine is also beneficial for cerebral vasoconstriction and increased CSF production. If the patient's headache remains after 24–48 hours of conservative therapy—or with persistent CSF leak for more than 24 hours—we apply an autologous blood patch. External catheter blockage, fracture, folding jam, and filter occlusion may be resolved without replacing a catheter. Otherwise, we reinsert the CSFD catheter when CSFD is needed for spinal cord protection. Coagulation status should be evaluated before the new insertion.

In summary, there are no standard protocols for perioperative management of CSFD (2). However, we believe the handling of CSFD is dependent on the rapid change of patient condition and clinical performance, risk from diseases, complexity of the surgery, and aortic team consensus. This article only introduces our three decades of clinical experience. Further studies using intraoperative neuromonitoring-guided CSFD in the repair of thoracoabdominal and descending thoracic aortic aneurysms are needed.

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Footnote

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