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SURGICAL PROCEDURE VIDEO

Cisternostomy: surgical technique and technical nuances in the management of intracranial hypertension

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Cisternostomy is a microsurgical strategy aimed at lowering intracranial pressure (ICP) by re-establishing cerebrospinal fluid (CSF) communication across basal cisterns. In contrast to decompressive craniectomy, it achieves effective relaxation of the brain while preserving the calvarium. Over the past decade, growing clinical data have supported its use in traumatic brain injury (TBI) and aneurysmal subarachnoid hemorrhage (SAH). This article provides a detailed, stepwise description of the operative technique, emphasises key anatomical landmarks, and highlights practical nuances that improve safety and completeness of decompression.

Keywords: cisternostomy, intracranial pressure, traumatic brain injury, subarachnoid hemorrhage, basal cisterns

Introduction

Intracranial hypertension is a pivotal determinant of outcome in acute brain injury. Conventional measures—osmotherapy, controlled ventilation, sedation, CSF diversion, and decompressive craniectomy—primarily mitigate downstream consequences rather than correcting disordered CSF circulation (1, 2). Decompressive craniectomy can be life-saving but carries recognised drawbacks, including external cerebral herniation, syndrome of the trephined, and the need for later cranioplasty (1). Cisternostomy offers a physiology-oriented alternative. By opening basal cisterns and restoring communication across subarachnoid compartments, it reduces cisternal pressure, improves fluid exchange, and may facilitate glymphatic clearance (3, 4). Accumulating reports suggest favourable effects on ICP control and functional outcomes in selected patients (5, 6).

Anatomical and physiological considerations

The basal cisterns—carotid, chiasmatic, interpeduncular, and prepontine—form a continuous CSF pathway around the skull base. Pathological states such as TBI and SAH disrupt this continuity through edema, blood products, and arachnoid adhesions, leading to compartmentalisation and pressure gradients (7, 8). A central structure is the Liliequist membrane, comprising diencephalic and mesencephalic leaves. Failure to open both layers limits communication with the prepontine cistern and results in incomplete decompression (7, 9). Basal cistern relationships are depicted in **Figure 1**, providing anatomical orientation for the procedure.

Indications and contraindications

Indications include severe TBI (GCS 3–8) with effaced cisterns, refractory ICP (>20 mmHg despite tiered therapy),

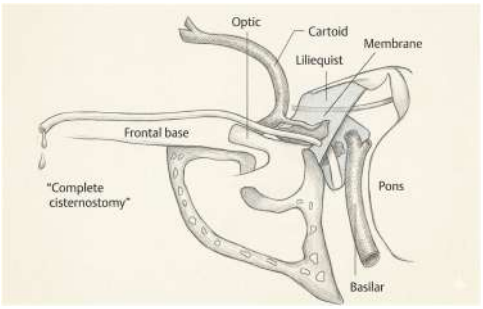

FIGURE 1 | Schematic of basal cistern anatomy demonstrating carotid, chiasmatic, interpeduncular, and prepontine compartments with the Liliequist membrane.

and aneurysmal SAH with substantial cisternal clot (5, 6, 10). The technique may be considered when decompressive craniectomy is contemplated but bone preservation is desirable. Contraindications include established brainstem failure, bilateral fixed dilated pupils, significant coagulopathy, and haemodynamic instability.

Operative technique

Stepwise microsurgical cisternostomy demonstrating Sylvian fissure dissection, exposure of the opticocarotid and chiasmatic cisterns, and progressive cerebrospinal fluid (CSF) release leading to brain relaxation mentioned in **Video 1**.

VIDEO 1 | Stepwise microsurgical cisternostomy demonstrating Sylvian fissure dissection, exposure of the opticocarotid and chiasmatic cisterns, and progressive cerebrospinal fluid (CSF) release leading to brain relaxation. Key anatomical landmarks and arachnoid membranes are highlighted to illustrate safe and effective decompression.
https://youtu.be/k9d-QQcuHrU

Anaesthesia and monitoring

General anaesthesia is administered with attention to maintaining cerebral perfusion pressure. Normocapnia, normothermia, and haemodynamic stability are targeted. An external ventricular drain (EVD) allows ICP monitoring and controlled CSF diversion (3).

Positioning

The patient is positioned supine with 15–20° contralateral head rotation and slight extension. Rigid fixation is used. This configuration promotes gravity-assisted frontal lobe relaxation and reduces the need for fixed retraction.

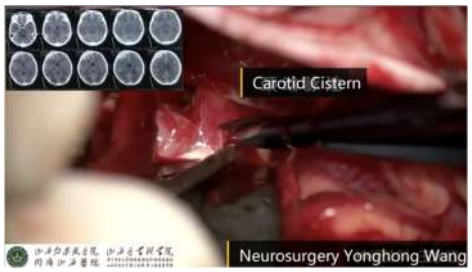

FIGURE 2 | Wide Sylvian fissure dissection showing exposure of the carotid cistern and arachnoid plane development.

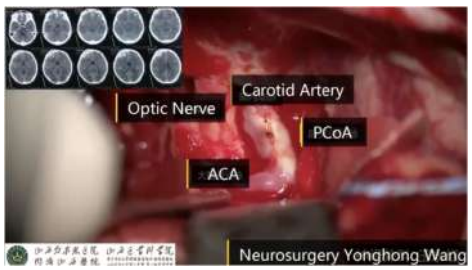

FIGURE 3 | Carotid cistern opening with identification of the internal carotid artery and optic nerve, demonstrating initial CSF egress.

Craniotomy and skull base preparation

A tailored pterional craniotomy is performed. Generous drilling of the sphenoid wing flattens the skull base, shortens the working corridor, and improves the angle of approach, thereby minimising retraction.

Extradural release

Extradural steps enhance exposure: division of the orbitomeningeal band, temporal dural peeling, and selective anterior clinoidectomy where indicated. These manoeuvres increase surgical freedom and decrease retraction-related risk (11).

Dural opening

A basal dural opening directed towards the sphenoid ridge facilitates early access to the Sylvian fissure and basal cisterns. The dura may be loosely approximated at closure to accommodate postoperative swelling.

Sylvian fissure dissection

Wide Sylvian fissure splitting is undertaken along arachnoid planes under high magnification. The M1 segment of the middle cerebral artery serves as a reliable guide to the carotid cistern. Preservation of Sylvian veins is essential to avoid venous infarction. Wide Sylvian fissure dissection with exposure of the carotid cistern is demonstrated in **Figure 2**.

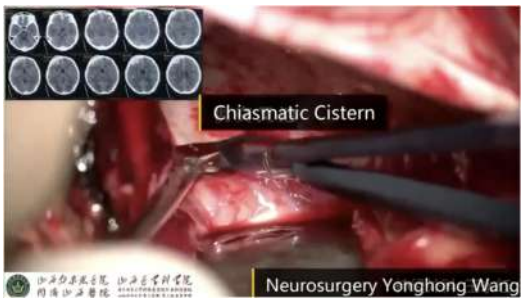

FIGURE 4 | Chiasmatic cistern exposure with optic chiasm and anterior communicating artery complex.

FIGURE 5 | Liliequist membrane before and after fenestration with entry into the prepontine cistern and basilar artery visualisation.

Carotid cistern opening

Opening the carotid cistern typically produces the first substantial CSF egress and visible brain relaxation. Key landmarks include the internal carotid artery, optic nerve, and A1 segment. Opening of the carotid cistern results in initial cerebrospinal fluid egress, as shown in **Figure 3**.

Chiasmatic cistern opening

Medial extension of the dissection opens the chiasmatic cistern, exposing the optic chiasm and anterior communicating artery complex. In SAH, dense adhesions are common and are best managed with sharp arachnoid dissection. Further medial dissection exposes the chiasmatic cistern and optic apparatus (**Figure 4**).

Liliequist membrane fenestration

Fenestration of the Liliequist membrane is pivotal. The oculomotor nerve must be identified prior to incision. Both diencephalic and mesencephalic leaves are opened to establish communication with the prepontine cistern; the basilar artery becomes visible when entry is adequate (7, 9). Fenestration of the Liliequist membrane, before and after opening, is illustrated in **Figure 5**.

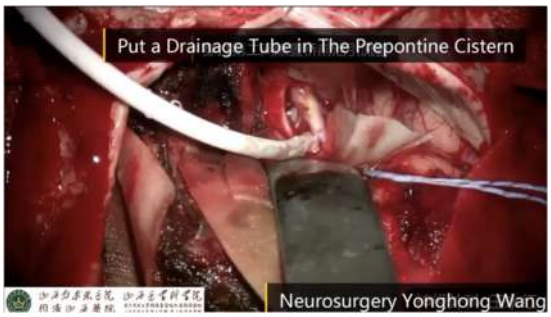

FIGURE 6 | Prepontine cisternal drain in situ along the ventral brainstem.

Prepontine cistern and drain placement

After membrane opening, the prepontine cistern is accessed. A soft silastic catheter is placed under direct vision along the ventral brainstem to enable continuous CSF drainage and, when required, gentle irrigation (10). Final placement of the cisternal drain within the prepontine cistern is demonstrated in **Figure 6**.

Closure

Meticulous haemostasis is achieved and the field is irrigated. The cisternal drain is secured. The dura is loosely approximated, and the bone flap is replaced to preserve cranial integrity while allowing expansion.

Surgical nuances and technical pearls

Brain relaxation should be used as the operative endpoint; persistent tension suggests incomplete decompression. All manoeuvres must remain within arachnoid planes, avoiding traction on neural or vascular structures. Perforating vessels around the carotid bifurcation and basilar apex require careful preservation to prevent infarction (12). In SAH, clot removal should be gradual with irrigation and gentle aspiration. Cranial nerve safety is paramount—particularly the oculomotor nerve during membrane fenestration and the abducens nerve in the prepontine region. Proper positioning and maintenance of the cisternal drain are essential for sustained postoperative effect.

Clinical evidence

Prospective and comparative studies report effective ICP reduction, decreased requirement for decompressive craniectomy, and improved functional outcomes following cisternostomy in selected cohorts (1, 2, 5, 6). In SAH,

early cisternal clearance may reduce vasospasm-related complications (10, 13). While high-quality multicentre data are still evolving, current evidence supports a physiological benefit when the technique is performed meticulously.

Conclusion

Cisternostomy directly addresses impaired CSF dynamics by restoring communication across basal cisterns. When executed with careful anatomical orientation and microsurgical discipline, it can achieve durable ICP control without removing the skull. Mastery of wide Sylvian fissure opening, sequential cisternal decompression, and complete Liliequist membrane fenestration is essential for consistent results.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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