

Surgical Management for Trapped Fourth Ventricle in Adult Patient: A Case Report

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ABSTRACT

Background: Trapped fourth ventricle (TFV) is a rare late complication of post-infectious or post-hemorrhagic hydrocephalus. It is a characteristic pathology of children that has rarely been described in adults. This entity is distinct from a large fourth ventricle because TFV entails pressure in the fourth ventricle and posterior fossa due to abnormal inflow and outflow of CSF, causing significant symptoms and signs.

Case description: In the present paper, the authors describe the case of a 29-year-old man who presented with an isolated fourth ventricle. The neurological examination revealed instability, dysarthria, and an alteration in normal swallowing. The imaging was correlated with the clinic. The patient was operated on twice. The first time, a fenestration and 4-ventricle-cistern magna shunt were performed with improvement in the patient but with recurrence in the clinic later. In the second surgery, a 4-ventricle peritoneal valve was implanted, with improvement maintained over time. There are multiple approaches to isolated 4th ventricle surgery: endoscopic approaches, open microsurgical approaches, shunts, and hybrid approaches. The literature shows that both endoscopy and microsurgery are the two modalities with the best results and fewer complications. Between both, our choice is microsurgery given its versatility, although it depends a lot on the surgeon's experience.

Conclusion: The surgical options (fenestration, more shunt ventricle-cistern magna, and shunt ventricle-peritoneal) are safe and effective alternatives in the treatment of trapped 4V with a very good long-term outcome and low rate of morbidity.

KEYWORDS: trapped fourth ventricle, hydrocephalus, posterior fossa craniotomy, fenestration, internal shunt.

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BACKGROUND

Its first diagnosis was in 1968 [1], and it still carries many controversial issues concerning its diagnosis and treatment. Entrapped fourth ventricle is the result of both inlet aqueduct and outlet fourth ventricular midline and lateral foraminae obstruction. It occurs, usually, as a sequela of an intracranial hemorrhagic or inflammatory disease condition. Usually, it presents after previous shunting for communicating hydrocephalus with a period of improvement, after which manifestations of the posterior fossa expanding process appear. The clinical diagnosis depends mainly on the new appearance of posterior fossa compressive symptoms after a relatively quiescent period [2].

CASE REPORT

29-year-old patient operated on in another hospital for a left acoustic neurinoma that presented as a complication of meningitis caused by Klebsiella pneumonia, which required the permanent placement of a peritoneal ventricular shunt. As sequelae, it presents brainstem syndrome with instability, incoordination, ataxia and functional impairment of low pairs with involvement of the left seventh pair. Currently, the patient presents a worsening of their usual symptoms with gait instability, dysfunction of the glottis and dysarthria. In the MRI an isolated fourth ventricle is observed that corroborates the patient's clinic [Figure 1]. The patient is operated on through a telovelar approach to

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the fourth ventricle and placement of a ventriculo-cistern magna shunt [Figure 2].

During surgery, a thickened arachnoid and a high cerebrospinal fluid pressure were observed. The external ventricular drainage catheter was left inserted from the fourth ventricle to the cistern and remained fixed. Postoperatively, the patient performs a good evolution with marked improvement of the instability, emphasizing the axial trunk control. Two months later, she returned to the same clinic, and given the suspicion of insufficient efficacy, it was decided to intervene again given the initial improvement that the patient showed.

The patient is operated on again on through a fourth ventricle-peritoneal shunt. Through the posterior fossa craniotomy, the previous derivation will be removed. A new catheter is introduced to the 4th ventricle in a microsurgical form and is subsequently fixed to the dura and to the muscular plane. Tunnelization of the catheter to the cervical region with placement of the valvular-peritoneal system. Postoperatively, the patient improves again, including the dysarthria that she previously presented. The improvement has been maintained in the 2 months that the follow-up has lasted.

DISCUSSION

The incidence of trapped fourth ventricle (TFV) has been estimated at 2%–3% of shunt-treated patients [2], although this figure likely underestimates the true prevalence, particularly in pediatric and post-infectious populations. TFV represents the final stage of a progressive obstructive process involving both the aqueduct of Sylvius and the outlets of the fourth ventricle, resulting in complete isolation of the fourth ventricle from the supratentorial CSF pathways [4,5].

The pathophysiology is closely linked to inflammatory processes within the ventricular system. Post-infectious and post-hemorrhagic states promote ependymal disruption and arachnoid scarring, leading to aqueductal stenosis and obstruction of the foramina of Magendie and Luschka. Over time, this results in progressive dilation of the fourth ventricle and exertion of mass effect on the brainstem and cerebellum [4,5].

In the present case, both prior posterior fossa surgery and *Klebsiella pneumoniae* meningitis likely contributed to the development of dense intraventricular adhesions. This dual mechanism is particularly relevant, as post-infectious TFV has been associated with more aggressive scarring and a higher rate of treatment failure, especially in endoscopic procedures [4,13].

From a clinical standpoint, TFV should be suspected in patients with prior CSF diversion who develop progressive brainstem symptoms. These include lower cranial nerve dysfunction, dysarthria, dysphagia, truncal ataxia, and gait instability [4]. Our patient's clinical course is paradigmatic, with progressive neurological deterioration correlating

closely with radiological findings. This clinico-radiological concordance remains the cornerstone for surgical indication, as radiological dilation alone does not necessarily mandate intervention.

One of the most debated aspects in TFV management is the timing of surgery. Early intervention may prevent irreversible brainstem damage; however, surgery in minimally symptomatic patients remains controversial. Some authors advocate a conservative approach in stable patients, whereas others support early surgical decompression to avoid long-term neurological deficits [4,10].

Regarding treatment strategies, no single technique has demonstrated clear superiority, and decision-making must be individualized. The three principal approaches—shunting, endoscopy, and microsurgery—each address different aspects of the underlying pathology.

Shunting procedures represent the most straightforward solution by directly decompressing the fourth ventricle. Historically, they have been considered the standard of care [4,8]. However, they do not restore physiological CSF circulation and are associated with significant long-term morbidity, including obstruction, infection, overdrainage, and mechanical failure [2,4]. Furthermore, the anatomical trajectory is critical: lateral transcerebellar approaches carry a higher risk of neurological injury, whereas the midline transforaminal route provides a safer and more anatomical pathway parallel to the brainstem [10].

Endoscopic approaches aim to re-establish physiological CSF pathways and avoid permanent implants. Techniques such as aqueductoplasty and aqueductal stenting have shown promising results, particularly in selected patients with favorable anatomy [12,13]. However, their success is highly dependent on the etiology of TFV. In post-infectious cases, restenosis rates are significantly higher due to ongoing inflammatory processes and adhesion formation [13]. Additionally, these techniques require ventriculomegaly and favorable ventricular anatomy, limiting their applicability.

Microsurgical approaches via suboccipital craniotomy offer the most comprehensive solution by directly addressing the pathological substrate. Through approaches such as the telovelar route, surgeons can perform wide fenestration, adhesiolysis, and selective placement of stents or shunts under direct visualization [6,7]. The telovelar approach has largely replaced the transvermian route due to its lower morbidity and preservation of cerebellar function [7].

A key advantage of microsurgery is its adaptability. In complex cases with severe arachnoiditis, it allows intraoperative decision-making tailored to the patient's anatomy. In our case, the initial strategy consisted of a ventriculo-cisternal shunt, aiming to restore CSF communication while avoiding a permanent distal system. However, the recurrence of symptoms suggests that partial restoration of CSF flow may be insufficient in cases with extensive scarring.

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This highlights a crucial concept: TFV is not a uniform entity but rather a spectrum of pathologies. In cases with mild obstruction, physiological restoration may be achievable. In contrast, in advanced cases with complete isolation and dense adhesions, definitive CSF diversion may be required.

The need for reoperation in our patient is consistent with the literature. The meta-analysis by Sadigh et al. [15], including 314 patients, demonstrated that revision surgery is required in up to 38% of cases, regardless of the initial technique. Interestingly, while endoscopic and microsurgical approaches achieve the highest rates of clinical improvement (approximately 98%), shunting procedures show slightly lower improvement rates but remain effective in refractory cases.

Importantly, microsurgical approaches were associated with the lowest rate of long-term complications (approximately 3%), suggesting that direct anatomical correction may provide more durable results in selected patients [15]. However, these results must be interpreted cautiously, as they are highly dependent on surgical expertise and case selection.

In our patient, the initial microsurgical attempt without permanent diversion provided only temporary benefit, whereas definitive treatment with a fourth ventricle–peritoneal shunt resulted in sustained clinical improvement. This reinforces the role of shunting as a salvage or definitive option in complex TFV, particularly in post-infectious cases. Another relevant aspect is the evolution of hybrid strategies, combining microsurgical and endoscopic techniques or staged procedures. These approaches aim to maximize efficacy while minimizing invasiveness, although current evidence remains limited [15].

Ultimately, the management of TFV requires a nuanced and individualized approach. Factors such as etiology, anatomical configuration, prior surgeries, and surgeon experience must all be considered. Rather than seeking a universal solution, the optimal strategy lies in selecting the most appropriate technique for each specific clinical scenario.

In this context, our case illustrates several key points: (1) the importance of recognizing post-infectious TFV as a high-risk entity, (2) the limitations of partial CSF restoration techniques in advanced disease, and (3) the continued relevance of shunting as a definitive treatment in selected patients.

Below is a list of series with TFV treated by craniotomy / posterior fossa craniectomy (Table 1).

CONCLUSION

Trapped fourth ventricle represents a complex and heterogeneous condition in which treatment must be tailored to the underlying etiology and anatomical configuration. While endoscopic and microsurgical approaches aim to

restore physiological CSF circulation, their efficacy may be limited in cases with severe post-infectious arachnoiditis.

Our case highlights that, in advanced or refractory TFV, partial restoration strategies may be insufficient, and definitive CSF diversion remains a reliable and effective option. Microsurgical approaches provide a versatile platform for individualized treatment, allowing intraoperative adaptation; however, the need for reintervention remains a significant challenge across all techniques.

Ultimately, optimal management requires a balance between durability, invasiveness, and complication risk, with surgical expertise playing a central role in achieving favorable outcomes.

List of abbreviations:

1. 4V: 4 ventricles
2. TFV: Trapped fourth ventricle
3. CSF: cerebrospinal fluid

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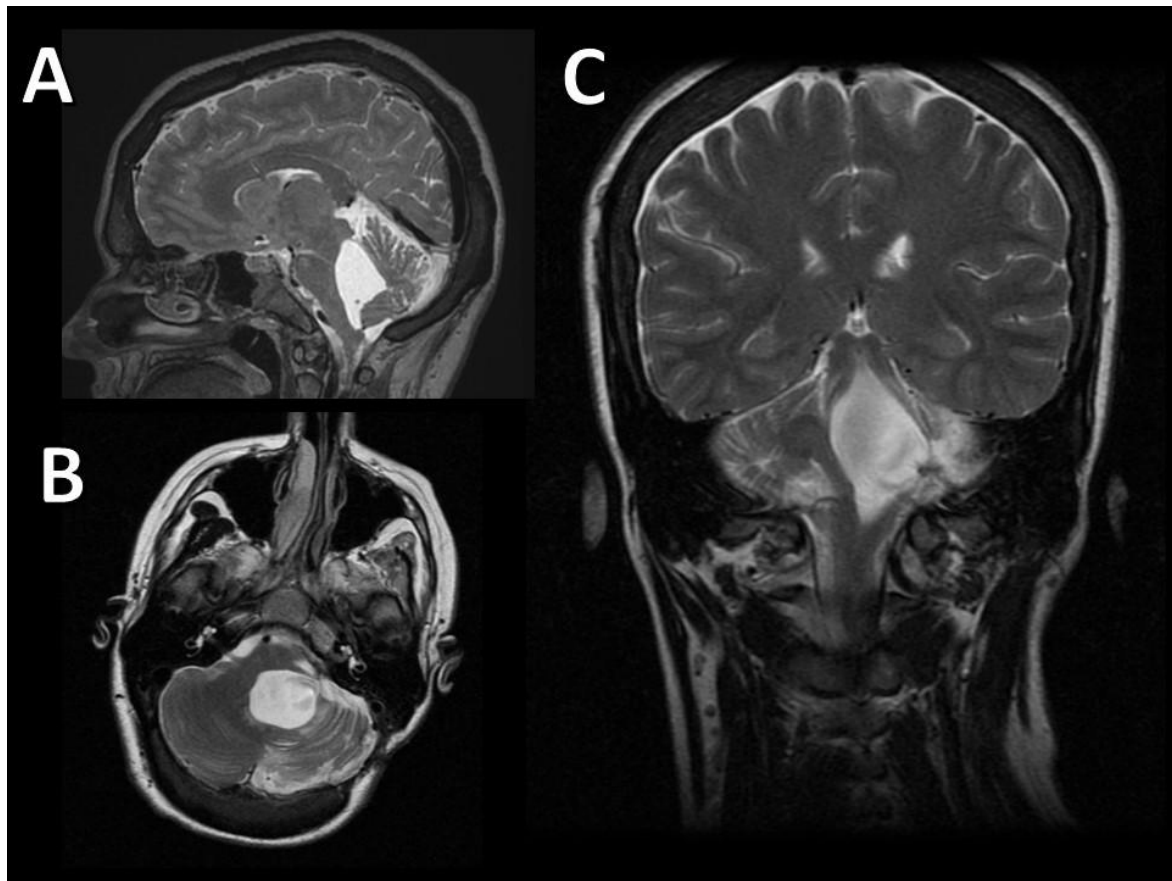
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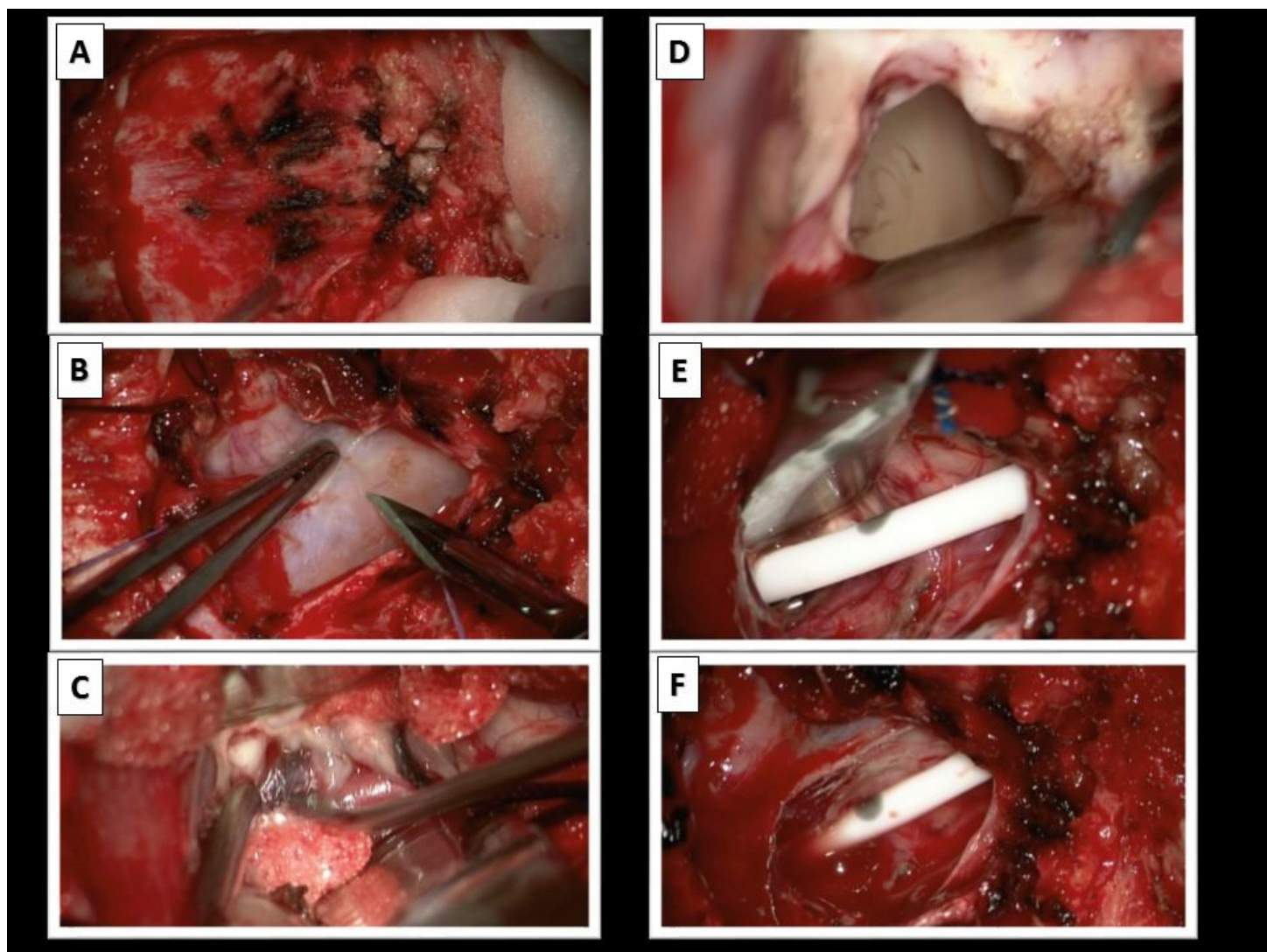
Figure legend

Figure 1: Preoperative MR Image. Image A: preoperative sagittal T2-weighted MR image. Enlarged trapped fourth ventricle and widened aqueduct. Image B: Axial T2-weighted MR image. Shrinkage of the fourth ventricle. Image C: Coronal T2-weighted MR image showing a large dilated fourth ventricle with mass effect on the brainstem.

Figure 2: Intraoperative images and description of the surgery

An occipital midline incision was made up to C2 and a midline suboccipital craniotomy. Later, a durotomy was performed in Y until cistern magnus, showing an arachnoid with a white and thickened coloration in the cerebelomedullary junction (A). After arachnoid opening (B) and separation of the ligaments, which were attached by flanges, a minimal corticotomy is performed in the lower vermis and choroidal tissue to access the 4th ventricle (D) Evidence of clear cerebrospinal fluid pressure is evident upon entering the 4th ventricle, which presents a brownish-colored membrane in the choroidal tissue. External ventricular drainage is inserted from 4th ventricle to cistern (E-F) and fixed with silk to dura mater





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Table 1: Review of the literature of all clinical cases of isolated 4V treated by craniotomies Yrs: years, mos: months.

	Patients	Clinical Presentation	Age	Technique	Complications	Outcome
Jerry L. Hubbard, et al. 1978 [17]	1	Deterioration of mental and neurological status	58 yrs	A bilateral suboccipital craniectomy and C-1 and C-2 laminectomies+shunt	No	Clinical improvement
Villavivencio et al 1998 [6]	6		3-20 yrs	Suboccipital craniectomy and open fenestration	No	5 of the 6 patients (83%) have remained asymptomatic
Dollo et al 2001 [1]	4		0.7-10 yrs	Craniectomy and fenestration, cyst-subarachnoid space shunt (3 pts had stent)	No	Good, no addl treatment
Dachling Pang, et al. 2005 [18]	1	Delayed, progressive palsies of the 6th, 7th, 10th, and 12th cranial nerves		Suboccipital craniectomy and C-1 aminectomy	No	Within 2 weeks, the sixth and seventh nerve palsies began to improve
Udayakumaran et al 2011 [7]	12		24.6 mos	Posterior fossa craniotomy/craniectomy and opening of the TFV into the spinal subarachnoid space. Cyst fenestration (6 stents)	One patient underwent a second TFV 21 months after the initial procedure.	All 12 patients (100%) showed clinical improvement
El Damaty et al. (2020) [19]	21	Brainstem dysfunction, headache, variable	Pediatric (mostly preterm)	Mixed (incl. craniotomy in selected cases, but mainly shunt/endoscopic)	Not specified (series heterogeneous)	Surgical treatment effective; early treatment improves outcomes
Dauda HA et al [20]	11	Headache, gait imbalance	Mean 23.5 yrs	Open posterior fossa fenestration (craniotomy-based)	Minimal	9/11 improved (~82%)
N. Ahmed et al. (2023) [21]	1	Acute deterioration, hydrocephalus	16 yrs	Midline suboccipital craniotomy (telovelar approach) + total resection	No	Complete recovery, no recurrence at 1 year
L. Chen et al. (2026) [22]	1	Headache, gait disturbance, vomiting	51 yrs	Median suboccipital craniotomy + microsurgical resection	No	Full recovery, no hydrocephalus post-op