Anterior contralateral interhemispheric transcallosal transforaminal approach for resection of large medial thalamic cavernous malformation: case report and 2D operative video

Raffaele De Marco[1]^, Andrea Gatto[1], Antonio Melcarne[2], Fabio Cofano[1,2]^, Diego Garbossa[1,2]^, Alessandro Fiumefreddo[2]

[1]Department of Neuroscience "Rita Levi Montalcini", University of Turin, Turin, Italy; [2]Neurosurgery Unit, "Città della Salute e della Scienza" University Hospital, Turin, Italy

Contributions: (I) Conception and design: R De Marco; (II) Administrative support: A Gatto; (III) Provision of study materials or patients: A Fiumefreddo, A Melcarne, D Garbossa; (IV) Collection and assembly of data: A Gatto; (V) Data analysis and interpretation: R De Marco; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Raffaele De Marco, MD, PhD student. Department of Neuroscience "Rita Levi Montalcini", University of Turin, Via Cherasco, 15, 10126, Turin, Italy. Email: raffaele.demarco@unito.it.

Background: Thalamic cavernous malformation (CM) are relatively rare lesions. Results came mainly from case report or small case series which were collected in specialized centers. Due to high risk of postoperative neurological deficits many of these are considered inoperable. However, an adequate approach selection can minimize the risk while reaching a satisfying extent of resection. An attempt to standardize the best surgical corridor to reach these deep lesions has been proposed by dividing the thalamus into 6 different regions.

Case Description: A case of bleeding CM of the medial region of the thalamus and its surgical management has been reported. A 35-year-old woman required urgent medical attention for progressive and unresponsive headache in the context of intracranial hypertension due to cerebrospinal fluid (CSF) obstruction at the level of the aqueduct. Imaging work-up showed a bleeding lesion of the right thalamus. In order to manage the hydrocephalus, an endoscopic third ventriculostomy (ETV) was performed without complications. After discharge, a new brain magnetic resonance imaging (MRI), one month later, showed increasing dimension of the lesion and signs of rebleeding. A contralateral interhemispheric transcallosal transforaminal approach was selected to approach the lesion. The subsequent course was uneventful with improvement of the left-hand tremor. The postoperative brain MRI confirmed the complete removal of the lesion and no sign of recurrence was shown at 3- and 12-month follow-up imaging.

Conclusions: Surgery of thalamic cavernomas is extremely complex. While there is a body of literature examining the optimal surgical corridors for lesions in different thalamic locations, the selection of the surgical approach must be tailored to the specific anatomy of each case, particularly for lesions with significant bulk that could alter regional anatomy.

Keywords: Case report; deep seated lesion; thalamus; cavernous malformation (CM); surgical approach

Received: 01 March 2025; Accepted: 05 June 2025; Published online: 22 August 2025.
doi: 10.21037/asj-25-17
View this article at: https://dx.doi.org/10.21037/asj-25-17

^ ORCID: Raffaele De Marco, 0000-0001-5187-4689; Fabio Cofano, 0000-0002-5100-7478; Diego Garbossa, 0000-0002-2692-7133.

Introduction

Background

Thalamic cavernous malformation (CM) are relatively rare deep seated benign lesions associated with significant neurological morbidity and mortality (1-4).

Although the absence of specific guidelines for thalamic and/or basal ganglia CM, surgical options can be considered when progressive enlargement or recurrent bleeds occurs. Furthermore, the proximity to the ventricular wall, the presence of a fixed neurological deficit and the location of the lesion in an eloquent region can influence the decision to intervene as well (5).

Indeed, the best surgical corridor has to be chosen in relation to the location of the CM and its relationship with the ventricular system, as well as surgeon's experience. Recently, Catapano *et al.* (6) defined 6 anatomical subtypes according to their predominant surface location: anterior malformations situated lateral and inferior to the foramen of Monro, medial malformations, surfacing the lateral wall of the third ventricle, lateral malformations which involve the ventral nuclei of the thalamus without direct pial or ventricular surfaces, choroidal malformations located in the superior thalamus forming the floor of the lateral ventricle body beneath the choroid plexus, pulvinar malformations situated in the posterior part of the thalamus and finally, geniculate malformations which involve the medial and lateral geniculate nuclei.

According to Rangel-Castilla (4), the medial thalamic CM can be accessed through an anterior contralateral interhemispheric transcallosal with few variants such as transforaminal (passing through the foramen of Monro) or transchoroidal, which allows larger anteroposterior movements (7). The contralateral corridor is indicated in case of large lesions or when they show an extension to the lateral thalamus. However, because of the rarity of the disease, findings are limited to small lesions and only very few results have been described about large CMs (≥25 mm).

Rationale and knowledge gap

Due to the rarity of the pathology and the difficulties associated to the deep location of the lesion, the majority of the cases who were described in the literature have been treated in few centers around the world. By applying a schematic classification which divides the thalamus into 6 regions and performing a thorough preoperative planning, the decision on the best surgical corridor made it possible to obtain a complete regression of the pre-operative symptoms while achieving the gross total resection of the lesion. Indeed, the detailed illustration of the surgical approach would offer some technical nuances for residents and young neurosurgeons in facing this type of corridor.

Objective

The aim of the current case report is to describe a step-by-step surgical procedure for the removal of a large thalamic CM through an anterior contralateral interhemispheric transcallosal (ipsilateral) transforaminal corridor. We present this article in accordance with the CARE reporting checklist (available at https://asj.amegroups.com/article/view/10.21037/asj-25-17/rc).

Highlight box

Key findings

- Safe surgical corridor for resection of thalamic wall cavernous malformation (CM).

What is known and what is new?

- Thalamic CMs are associated with significant neurological morbidity and mortality.
- This work shows a step-by-step interhemispheric corridor to safely reach deep-seated mass.

What is the implication, and what should change now?

- A thorough surgical planning is the key to perform thalamic mass asportation that would otherwise be considered inoperable.

Case presentation

A 35-year-old female with no relevant past medical history sought emergency medical attention for the worsening of intense headache and nausea. The neurological examination was intact except for resting and action tremor on her left hand.

A brain computed tomography (CT) scan was performed, revealing an expanding mass with irregular, mildly hyperdense content in the right thalamus causing a triventricular hydrocephalus. A CT-angiography did not show any other vascular malformation. To better typify the mass a contrast enhanced magnetic resonance imaging (MRI) was carried out (*Figure 1A*). The mass appeared well-defined, located on the medial thalamic portion with intralesional bleeding. The lesion displaced the tectum of the midbrain posteriorly causing a medial deformation

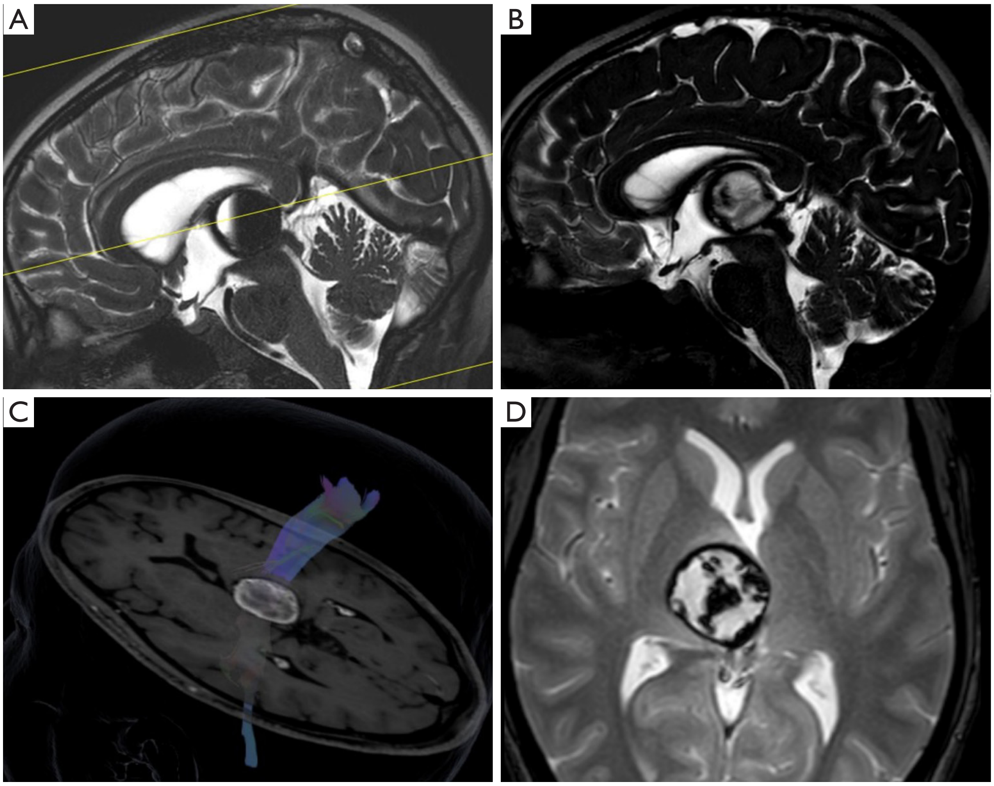


Figure 1 Preoperative images. (A) Initial brain MRI sagittal T2 weighted sequence shown a circumscribed right thalamic mass with aqueductal stenosis and supratentorial ventricular enlargement; (B) sagittal T2-weighted sequence one month after endoscopic third ventriculostomy and patency of the ventriculostomy (flow artifacts in the interpeduncular cistern); (C) relationship of the thalamic lesion with the corticospinal tract reproduced after tractography on Brainlab software; (D) axial T2-weighted sequence of the lesion measuring 29 mm (AP) × 27 mm (LL) and 11 cm^3 after segmentation on Brainlab software. AP, anteroposterior; LL, laterolateral; MRI, magnetic resonance imaging.

of the third ventricle. The corticospinal tract (CST) did not appear to be involved by the lesion but was displaced laterally, as shown in *Figure 1B*. Perfusion and spectroscopy MRI were performed to rule out tumor, but their specificity was low because of high blood contents. The first working diagnosis was a vascular malformation. In this context, no sign of developmental venous anomaly was highlighted.

To better understand the behavior of the lesion, we decided to firstly treat the urgent situation of hydrocephalus by the mean of endoscopic third ventriculostomy (ETV).

After this procedure, the symptoms related to high intracranial pressure resolved and the patient was discharged home after three days. Due to the possibility of close follow-up registering any minimal changes in her clinical state, an initial wait-and-see approach was preferred in order to observe the behavior of the lesion and better plan a possible surgical procedure.

One month after the ETV, a second brain MRI (*Figure 1C*) showed, on the one hand, a complete resolution of the hydrocephalus whit a good patency of the ventriculostomy, but, on the other hand, a size increase of the thalamic mass (29 mm × 28 mm; 11.0 cm^3 *vs.* 25 mm × 24 mm; 8.3 cm^3 of the initial dimension at presentation) with further signs of intralesional bleeding (*Figure 1D*).

Due to imaging findings (on MRI), the lesion's dimensions, and its progressive growth, neither conservative treatment nor radiosurgery were considered for this patient.

Considering the aforementioned information and taking into account the anatomical location of the lesion, we opted to perform a microsurgical resection of the thalamic lesion through an anterior contralateral interhemispheric transcallosal corridor in order to prevent further clinical worsening due to additional growth or re-bleeding.

Pathology examination was necessary to rule out other less probable hypothesis such as neurocytoma or neurocysticercosis.

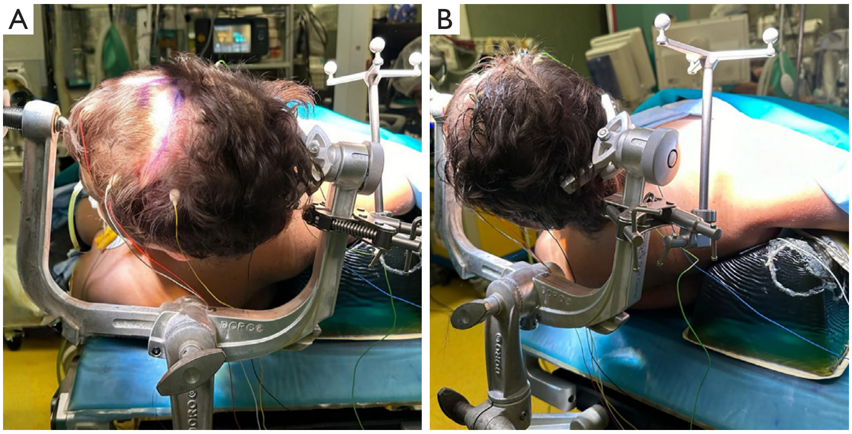


Figure 2 Different views of intraoperative setup (A,B): supine position with homolateral shoulder elevated and head rotated contralaterally, this allows gravitational retraction of the contralateral hemisphere providing a safe corridor limiting damage of the brain tissue.

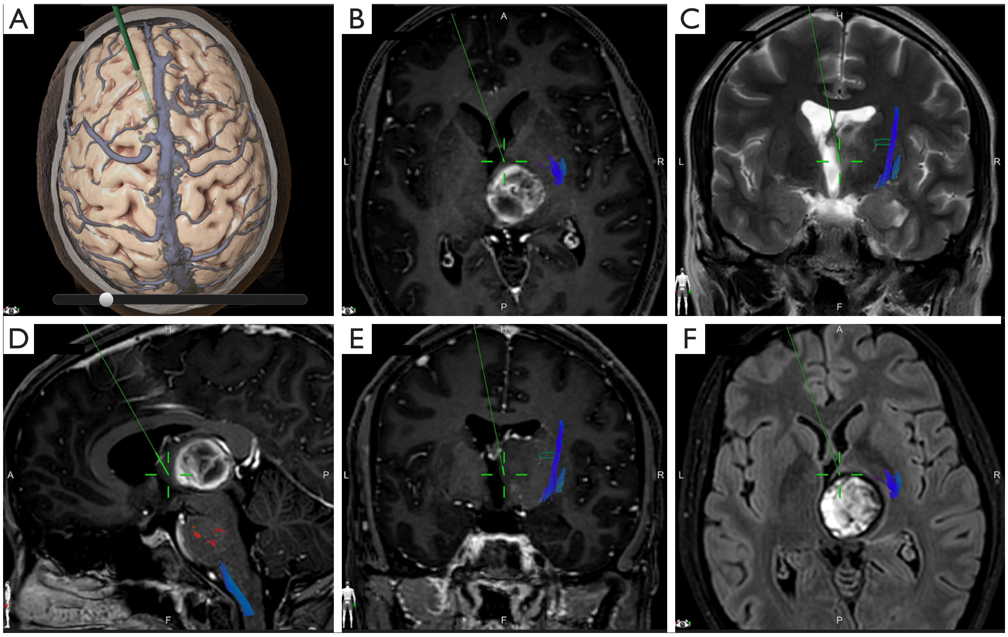


Figure 3 Intraoperative definition of the trajectory with the aid of the neuronavigation system (Brainlab). (A) Tridimensional view with cortical and venous system reconstruction for planning craniotomy over the superior sagittal sinus; (B,D,E) contrast-enhanced T1-weighted images with diffusion tensor imaging integration; (C) T2-weighted sequence; (F) fluid-attenuated inversion recovery sequence.

After careful surgical planning, considering the relationship with the surrounding structures, such as the position of the CST, an anterior contralateral interhemispheric transcallosal corridor was selected.

The possibility of forniceal and thalamic injuries was taken into account and weighted against further bleeding and neurological worsening (8).

The patient was positioned supine with right shoulder elevated and head rotated to the left and flexed upward to allow gravitational retraction of the left hemisphere (*Figure 2*). The neuronavigation and the operative microscope were used for this procedure as well as the intraoperative neuromonitoring for motor and somatosensory evoked potentials. The neuronavigation allowed to plan a large enough craniotomy for angulation of the surgical instrument by checking the surgical trajectory to the lesion (*Figure 3*).

Furthermore, taking into consideration the trajectory was essential to plan the most suitable callosotomy, limiting its injury.

Detailed surgical steps are discussed in the operative video (*Figure 4* and *Video 1*).

The procedure was uneventful and the preoperative left-hand tremor improved progressively after surgery. A non-contrast CT scan was performed on the first day after surgery to rule out any acute postoperative complications. She was discharged home 3 days after surgery.

The results of the pathology examination confirmed the diagnosis of CM. A contrast-enhanced brain MRI performed 30 days after surgery confirmed the complete resection of the lesion and no sign of recurrence was highlighted at 3- and 12-month brain MRIs (*Figure 5*).

After 1 year, the symptoms completely resolved and she came back to work without complaining of memory loss.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and the Declaration of Helsinki and its subsequent amendments. The patient consented to the procedure and to the publication of this case report, the accompanying images, and the video in their anonymous form. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

Thalamic cavernomas present unique challenges in the management due to their deep location and potential for significant neurological impairment, which makes them not too different from their brainstem counterparts (6). If in the past a substantial proportion of patients were managed conservatively, the evolution of surgical corridors and adjuncts such as neuromonitoring and neuronavigation allowed to remove these lesions with low neurological morbidity. However, the number of patients is still scarce and the actual results are based mainly on retrospective single centre series.

This report presents the case of a thalamic cavernoma resection, resulting in an excellent clinical outcome.

Searching Medline/PubMed and the Embase databases on January 2025 regarding the surgical approach for thalamic CMs (thalamic cerebral cavernous malformation [MeSH] AND surgical approach [MeSH]), only 28 articles from the English literature (among case series and case reports) treated adult thalamic CMs. In the end, a smaller number used the anterior contralateral interhemispheric transcallosal approach (15/28), collecting 75 patients overall. Considering the largest series of thalamic CMs approached through this type of surgical corridor, the average size of the lesion was around 20 mm (4,6,9). Percentage of residuals was always favorable as well as the neurological outcome whose results depended on the initial neurological status.

Although few variations have been proposed (transforaminal or transchoroidal fissure), the anterior contralateral interhemispheric transcallosal approach allows to manage those lesions that may origin in the medial region of the thalamus, but for their dimensions could extend in the lateral region. The extension of the lesion in the lateral region requires, indeed, to take advantage from the contralateral corridor avoiding excessive retraction on the brain parenchyma to increase the angle of attack for the instruments.

Our strategy focused initially on addressing the acute obstructive hydrocephalus and subsequently monitoring the lesion's behavior through follow-up MRI in order to plan the best surgical strategy.

The initial presentation of hydrocephalus was characterized by acquired obstructive features. The large size of the lesion caused aqueductal stenosis leading to cerebrospinal fluid (CSF) accumulation in the supratentorial ventricular system. The optimal intervention to address the hydrocephalus was determined to be an ETV for two primary reasons. First, the presence of an expansive mass at the thalamic level created a pressure gradient between the supratentorial and infratentorial CSF spaces. This pressure differential underpins the effectiveness of this type of diversion measure, allowing CSF to flow through the created opening in the floor of the third ventricle, thereby equilibrating pressure between the two compartments. The alternative of ventriculoperitoneal shunting (VPS) was not considered due to its requirement for implantable devices, which carry an increased risk of complications.

Surgical decision and approach

Follow-up imaging revealed lesion growth and additional signs of bleeding, prompting surgical intervention. The chosen approach was a contralateral transcallosal ipsilateral transforaminal corridor.

Various approaches to thalamic lesions are documented in the literature. In this case, a homolateral interhemispheric approach was deemed suboptimal due to the limited visualization it would provide, particularly of the lateral portion of the lesion. The contralateral approach, by

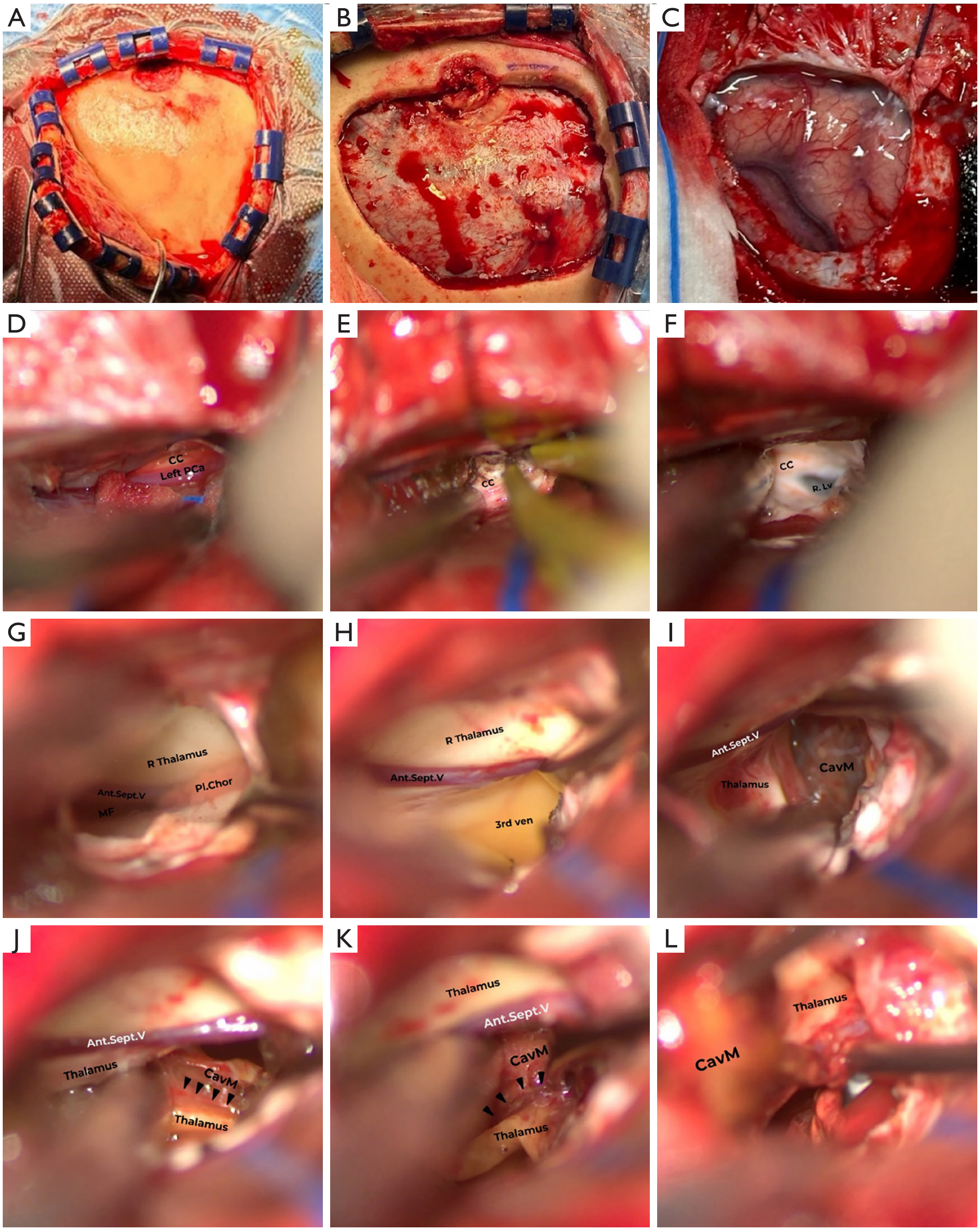
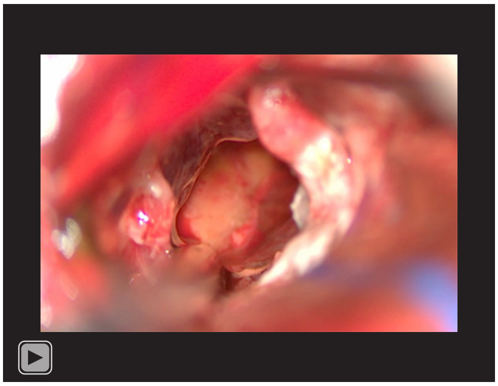


Figure 4 Surgical steps. Cranial exposure (A). Paramedian craniotomy with single burr hole on the SSS (B). U-shape dural opening flipped over the SSS (C). Interhemispheric fissure dissection and exposure of PCa and CC (D). CC is coagulated with preservation of PCa (E). Callosotomy is made to enter into the R.Lv (F). MF is identified alongside Pl.Chor and Ant.Sept.v (G). Pl.Chor is coagulated to increase access in the 3rd ven, MF is entered with the exposure of the medial thalamic wall which appears yellowish due to hemosiderin deposits (H). Checking with neuronavigation, the medial thalamic wall is accessed where the lesion surfaces it. After coagulation, the gliotic brain tissue and the hemosiderin rim of the lesion (CavM) came into view (I). Gentle dissection of the lesion from the brain tissue is alternated to blood clots aspiration. Surgical plane is indicated by arrowheads (J,K). Final detachment (L) and exploration of the surgical cavity with no evidence of residuals. 3rd ven, third ventricle; Ant.Sept.v, anterior septal vein; CavM, cavernous malformation; CC, corpus callosum; MF, Monro foramen; PCa, pericallosal artery; Pl.Chor, choroid plexus; R.Lv, right lateral ventricle; SSS, superior sagittal sinus.

contrast, offered superior visualization and improved maneuverability during resection.

An alternative approach described in the literature is the supracerebellar infratentorial route. However, this approach is more appropriate for lesions located in the posterior thalamic regions, such as the pulvinar or geniculate nuclei. In our case, the lesion was predominantly anteromedial, near the third ventricle. Additionally, the supracerebellar infratentorial approach is constrained by the limited working space and the presence of critical venous structures in this area, increasing the risk of accidental damage during surgery.



Video 1 Anterior contralateral interhemispheric transcallosal transforaminal approach: operative video.

Advantages of the chosen approach

The contralateral interhemispheric transcallosal transforaminal approach, in our opinion, represents the optimal choice for similar cases. By utilizing the transforaminal route, the medial wall of the thalamus can be accessed via the third ventricle. This approach, guided by neuronavigation, facilitated localization of the most superficial portion of the lesion while minimizing damage to

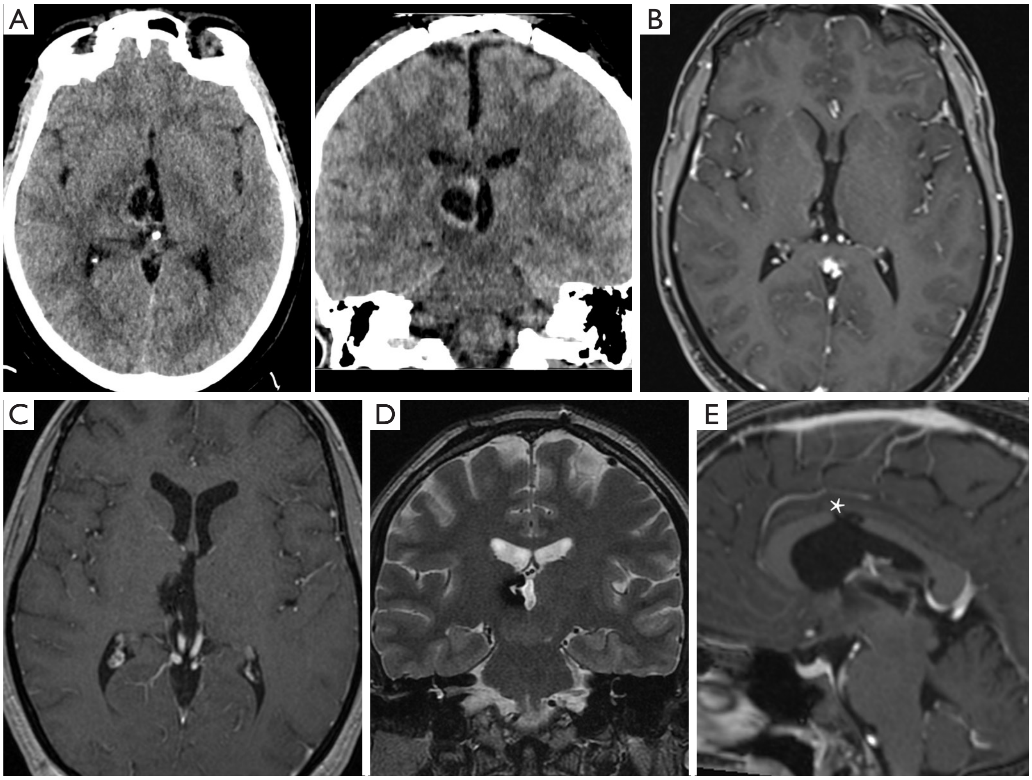


Figure 5 Postoperative images. (A) It shows axial and coronal cuts of the immediate postoperative CT scan; (C) axial cut of the contrast-enhanced T1-weighted MRI performed at 1 month after surgery, showing no sign of pathological enhancement; (D) coronal cut of T2-weighted brain MRI performed at 3 months; (B,E) axial and sagittal cuts, respectively, of the contrast-enhanced T1-weighted performed at 12 months, showing further reduction of the resection cavity; a white asterisk in the sagittal cut (E) wants to highlight the result of the callosotomy. CT, computed tomography; MRI, magnetic resonance imaging.

the healthy brain parenchyma. The availability of variation such as the transchoroidal one allows great ductility expanding the working angle for lesions more posteriorly located.

Limitations

Postponing surgery could have led to further neurological deterioration (e.g., motor or sensory deficits, cognitive impairment) due to repeated bleeding or compression of adjacent structures like the CST or thalamocortical pathways. Additionally, while ETV temporarily relieved the hydrocephalus, the persistent lesion growth posed a risk of recurrent CSF obstruction or secondary complications, such as intraventricular hemorrhage. However, the short delay allowed for better surgical planning, demonstrating that careful timing—balancing urgent intervention against optimal preparation—is critical in high-risk thalamic lesions. Regarding outcome, the relatively short follow-up period could not capture long-term recurrence or subtle cognitive and memory deficits which have not been investigated properly (neuropsychological tests). Being a case report, we are aware of limitation regarding generalizability of the result. In the end, the approach's success heavily depends on surgeon expertise and whatever the area affected by the lesion, the choice of the best approach depends greatly on this.

Conclusions

Surgical resection of deep-seated CM is indicated when symptomatic and when a feasible surgical route can be performed.

Thalamic CM can present with obstructive hydrocephalus and its management has priority over the resection of the lesion itself.

The interhemispheric contralateral transcallosal transforaminal route is a safe surgical corridor to reach medial thalamic CM, especially when the lesion surfaces the third ventricle.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://asj.amegroups.com/article/view/10.21037/asj-25-17/rc

Peer Review File: Available at https://asj.amegroups.com/article/view/10.21037/asj-25-17/prf

Funding: None.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://asj.amegroups.com/article/view/10.21037/asj-25-17/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and the Declaration of Helsinki and its subsequent amendments. The patient consented to the procedure and to the publication of this case report, the accompanying images, and the video in their anonymous form. A copy of the written consent is available for review by the editorial office of this journal.

References

1. Mathiesen T, Edner G, Kihlström L. Deep and brainstem cavernomas: a consecutive 8-year series. J Neurosurg 2003;99:31-7.
2. Li D, Zhang J, Hao S, et al. Surgical treatment and long-term outcomes of thalamic cavernous malformations. World Neurosurg 2013;79:704-13.
3. Kearns KN, Chen CJ, Tvrdik P, et al. Outcomes of basal ganglia and thalamic cavernous malformation surgery: A meta-analysis. J Clin Neurosci 2020;73:209-14.
4. Rangel-Castilla L, Spetzler RF. The 6 thalamic regions: surgical approaches to thalamic cavernous malformations, operative results, and clinical outcomes. J Neurosurg

2015;123:676-85.
5. Abla AA, Spetzler RF. Cavernous malformations of the thalamus: a relatively rare but controversial entity. World Neurosurg 2013;79:641-4.
6. Catapano JS, Rumalla K, Srinivasan VM, et al. A taxonomy for deep cerebral cavernous malformations: subtypes of thalamic lesions. J Neurosurg 2023;139:1681-96.
7. Winkler EA, Lawton MT. Transcallosal-Transchoroidal Fissure Approach for Midbrain and Thalamic Cavernous Malformations: 2-Dimensional Operative Video. Oper Neurosurg 2024;26:347-8.
8. Lawton MT, Golfinos JG, Spetzler RF. The contralateral transcallosal approach: experience with 32 patients. Neurosurgery 1996;39:729-34; discussion 734-5.
9. Zaidi HA, Chowdhry SA, Nakaji P, et al. Contralateral interhemispheric approach to deep-seated cavernous malformations: surgical considerations and clinical outcomes in 31 consecutive cases. Neurosurgery 2014;75:80-6.

doi: 10.21037/asj-25-17
Cite this article as: De Marco R, Gatto A, Melcarne A, Cofano F, Garbossa D, Fiumefreddo A. Anterior contralateral interhemispheric transcallosal transforaminal approach for resection of large medial thalamic cavernous malformation: case report and 2D operative video. AME Surg J 2025;5:33.