



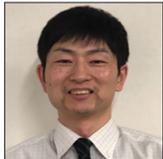
Case Report

# Trans-lamina terminalis approach assisted by endovascular temporary basilar artery occlusion for high-positioned, recurrent, basilar tip aneurysm: A technical case report

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## ABSTRACT

**Background:** Coil embolization is increasingly becoming the surgical intervention of choice for cerebral aneurysms, particularly for those in the posterior circulation. However, in cases where it is difficult to perform coil embolization, microsurgical clipping is still required.

**Case Description:** We present a case of a high-positioned, ruptured, recurrent basilar tip aneurysm treated with a combination of microsurgical clipping through the trans-lamina terminalis approach and endovascular procedure. The technical considerations of this approach are discussed.

**Conclusion:** Microsurgical clipping through the trans-lamina terminalis approach combined with an endovascular technique can be effective for basilar tip aneurysms. This approach is particularly useful for high-positioned, small, anterior projective aneurysms and cases with dilation of the third ventricle due to hydrocephalus or clot.

**Keywords:** Basilar artery, Hybrid surgery, Intracranial aneurysm, Terminalis approach, Trans-lamina

## INTRODUCTION

Executing a microsurgical approach to resolve a high-positioned basilar tip aneurysm is one of the most difficult operations in the field of neurosurgery. Coil embolization has facilitated the procedure and has thus become an increasingly widespread treatment option; however, in cases where endovascular treatment is not suitable, microsurgical clipping of the aneurysm is necessary. Herein, we describe a case of a high-positioned, recurrent basilar tip aneurysm treated through the trans-lamina terminalis approach assisted by endovascular temporary basilar artery occlusion.

## CASE REPORT

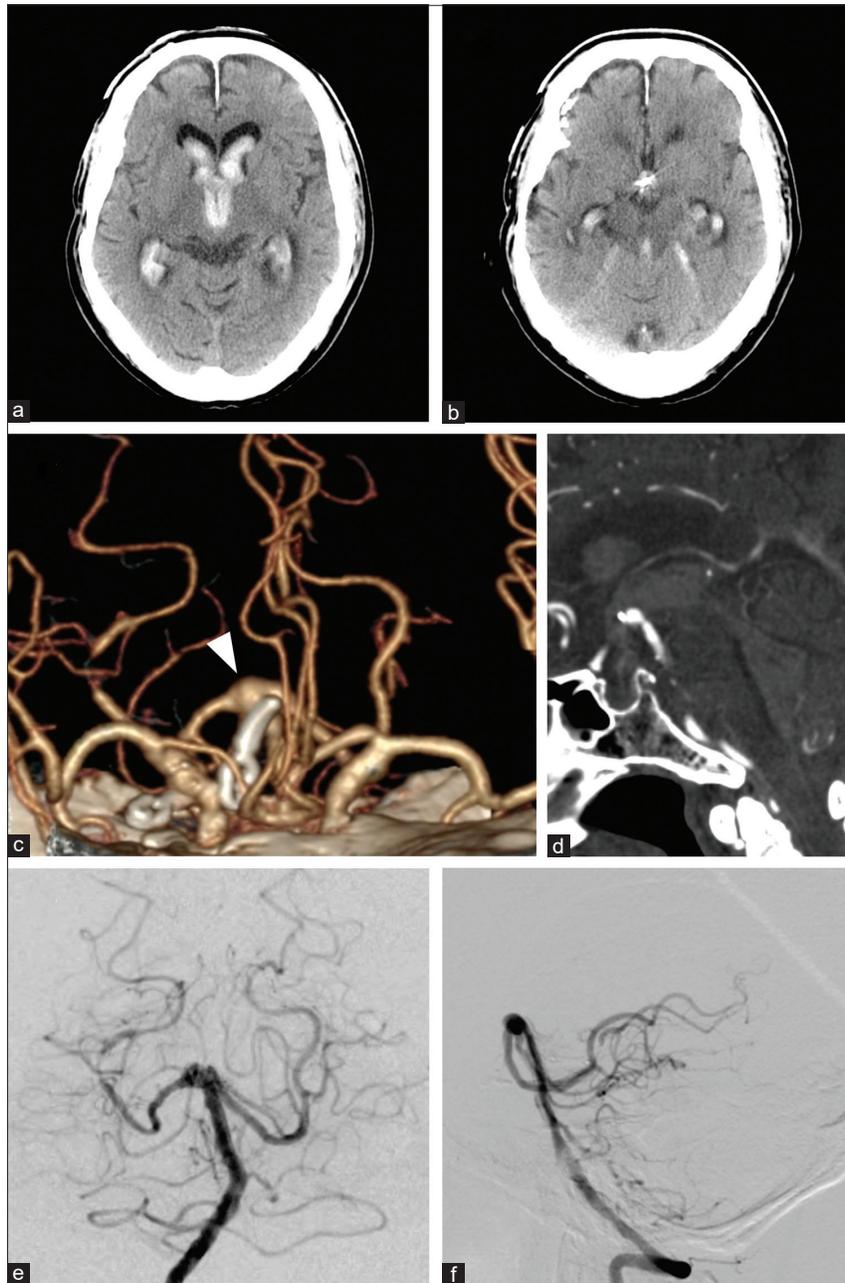
An 80-year-old man presented with a severe headache of sudden onset and nausea. His medical history included the surgical clipping of a ruptured basilar tip aneurysm and unruptured

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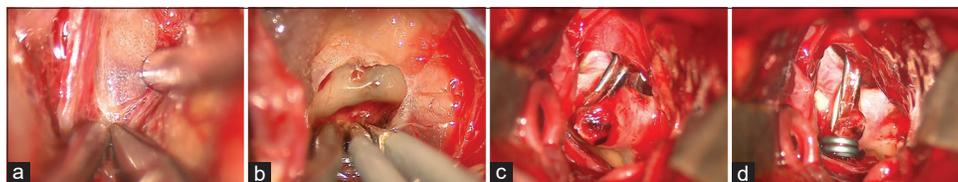
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right internal carotid-posterior communicating aneurysm through the right orbitozygomatic approach 14 years ago. On admission, he exhibited a mild disturbance of consciousness, with a Glasgow Coma Scale score of 14. Computed tomography (CT) revealed clots in all ventricles [Figure 1a and b]. Three-dimensional CT angiography and digital subtraction angiography showed only a small bulge on the right side of the previously applied clip

[Figure 1c-f]; this could not be confirmed as the source of hemorrhage. We adopted a strategy of conservative therapy with subsequent radiographical imaging. Although repeated angiography on day 14 revealed no further information, the patient recovered well, and surgical repair was planned considering the desire of the patient and his family to proceed with the treatment of the possible source of bleeding.



**Figure 1:** Preoperative images. (a and b) Computed tomography (CT) showing a clot in the third ventricle surrounding the previously applied clip; (c) three-dimensional (3D) CT angiogram showing a tiny bulge on the right side of the previously applied clip (arrow); (d) sagittal view of the 3D CT angiogram showing the distance between the basilar tip and the posterior clinoid process: 15 mm; (e and f) preoperative digital subtraction angiogram showing a tiny bulge on the right side of the previously applied clip and no other bleeding source.



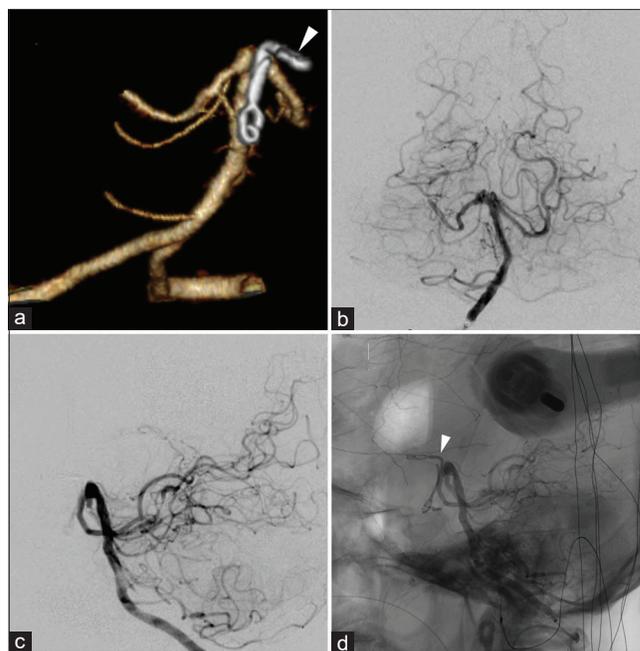
**Figure 2:** Intraoperative images. (a) Lamina terminalis; (b) entrance into the third ventricle after the lamina terminalis was opened; (c) after the third ventricle floor was opened, a red friable bulge on the right side of the previous clip was confirmed. A thrombus on top of the tiny bulge was observed and confirmed to be a bleeding source; (d) L-shaped clip applied under the previous clip.

Considering the shape of the small bulge and the lack of space into which the coil could be inserted, the use of coil embolization, even in conjunction with the stent-assisted technique, was precluded. Several microsurgical approaches including the pterional, subtemporal, temporopolar, and orbitozygomatic approaches were thought to be impractical due to the topography of the aneurysm and the previously applied clip. We selected the trans-lamina terminalis approach. To prepare for a premature rupture, we decided to incorporate the endovascular technique in the hybrid operation room (OR). Through bifrontal craniotomy, the interhemispheric fissure was widely dissected. Subsequently, a 4-Fr guiding sheath was inserted through the right femoral artery and was advanced to the left vertebral artery. A balloon microcatheter (HyperForm<sup>®</sup>, 7 mm × 7 mm) was placed at the basilar artery for proximal flow control. Opening of the third ventricle was performed through the trans-lamina terminalis approach [Figure 2a and b]. On opening the floor of the third ventricle, a red friable bulge found on the right side of the previous clip was confirmed as the bleeding source [Figure 2c]. Under flow control using the balloon microcatheter, an L-shaped clip was applied to the aneurysm [Figure 2d].

The patient's postoperative course was uneventful [Figure 3]. He exhibited no apparent neurological changes, electrolyte abnormalities, endocrine disturbances, or abnormal thermoregulation. However, his level of consciousness gradually worsened at 2-week postoperative due to hydrocephalus; this was resolved with a ventriculoperitoneal shunt. The patient required rehabilitation due to disuse atrophy and was, therefore, transferred to a rehabilitation hospital at 3 months after admission.

## DISCUSSION

Basilar tip aneurysms have traditionally been the most difficult cerebral aneurysms to clip, and nowadays, coil embolization has become an increasingly common treatment option. However, in this case, the bleeding source was only a small bulge, and there was no space for coil insertion even with the use of an adjunctive technique; thus, endovascular treatment was impossible. The major surgical interventions include the pterional and subtemporal approaches,<sup>[3,22]</sup>



**Figure 3:** Postoperative images. (a) Postoperative three-dimensional computed tomography angiogram; (b-d) postoperative digital subtraction angiogram showing the presently applied clip (arrow).

with various variations (e.g., zygomatic, temporopolar, and orbitozygomatic approaches<sup>[6,8,15,20-22]</sup>). The advantages of the pterional approach include the familiarity of the procedure to many surgeons and its provision of a wide exposure of the interpeduncular cistern. Conversely, the subtemporal approach allows access to the proximal part of the basilar artery before conforming to the aneurysm. However, these approaches have significant limitations for high-positioned basilar tip aneurysms located in the third ventricle. In our case, the clot in the third ventricle strongly suggested that the bleeding source was situated at the rear of the third ventricle, and the anterior approach was used through the lamina terminalis for good visualization.

Trans-lamina terminalis approach is rarely selected for basilar tip aneurysms; only six cases have been reported.<sup>[2,7,10,17]</sup> One of the disadvantages of this approach is the narrow surgical field. Hidaka *et al.* reported the average area of lamina terminalis to be 52.84 mm<sup>2</sup> (31.5–83.25 mm<sup>2</sup>); the

trans-lamina terminalis approach is optimal for selected aneurysms of 5 mm or less in size,<sup>[7]</sup> although dilation of the third ventricle due to associated hydrocephalus can provide a greater surgical space.<sup>[2,7,10,17]</sup> In our case, the bleeding source was a small bulge, and the third ventricle was dilated and filled with clot. Hence, the selection of the trans-lamina terminalis approach seemed reasonable.

Transient hypothermia, endocrine disturbances, and memory impairment may occur following this approach.<sup>[2,7,10]</sup> These complications may be associated with the effect of retraction on the hypothalamic nucleus surrounding the third ventricle. In the present case, no new symptoms were observed after surgery, although hydrocephalus was confirmed 2 weeks after the operation.

Furthermore, the trans-lamina terminalis approach involves the risk of a premature rupture of the aneurysm without safe control of the proximal segment of the artery. To overcome this disadvantage, we combined this surgical approach with endovascular proximal control by placing and inflating a balloon microcatheter in the hybrid OR, which is fully equipped with digital subtraction angiography. There are few reports on the use of temporary balloon occlusion during surgical intervention for vertebrobasilar aneurysms.<sup>[1,11,16,18,19]</sup> Catheter techniques are known to be associated with serious thromboembolic complications; however, a brief inflation time decreases the risk of developing thrombotic material that could spread after balloon deflation.<sup>[19]</sup> We used an irrigated catheter with heparinized saline flush and inflated the balloon within a period of 5 min to avoid thromboembolic complications.

To the best of our knowledge, this is the first report of a combined application of the trans-lamina terminalis approach with an endovascular technique. As this case demonstrates, the recent development of the hybrid OR has provided new strategies for neurosurgeons to approach complex basilar tip aneurysms.<sup>[4,5,9,12-14]</sup>

## CONCLUSION

Microsurgical clipping through the trans-lamina terminalis approach combined with an endovascular technique can be effective for basilar tip aneurysms. This approach is particularly useful for high-positioned, small, anterior projective aneurysms and cases with dilation of the third ventricle due to hydrocephalus or clot.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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