



## Case Report

# Trauma may affect vasa vasorum to promote thrombosis and enlargement of intracranial aneurysms: A case report

Mitsuhiro Anan<sup>1</sup>, Yasuyuki Nagai<sup>2</sup>, Takeshi Matsuda<sup>1</sup>, Minoru Fujiki<sup>3</sup>

<sup>1</sup>Department of Neurosurgery, National Hospital Organization Beppu Medical Center, Beppu, <sup>2</sup>Department of Neurosurgery, Oita Prefectural Hospital, Oita,

<sup>3</sup>Department of Neurosurgery, Faculty of Medicine, Oita University, Yufu, Oita, Japan.

E-mail: \*Mitsuhiro Anan - anmitsu@oita-u.ac.jp; Yasuyuki Nagai - y-nagai20@oitapref-hosp.jp; Takeshi Matsuda - tmatsuda@oita-u.ac.jp; Minoru Fujiki - fujiki@oita-u.ac.jp

### \*Corresponding author:

Mitsuhiro Anan, M.D., Ph.D  
Department of Neurosurgery,  
National Hospital Organization  
Beppu Medical Center, Beppu,  
Oita, Japan.

anmitsu@oita-u.ac.jp

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## ABSTRACT

**Background:** Thrombosed intracranial aneurysm (IA) is likely to occur in large or giant IAs. Almost all thrombosed IAs are found already in a thrombosed state, and few reports have depicted the process of thrombosis in unthrombosed aneurysm. Moreover, no reports appear to have described IA in which thrombosis accelerated after trauma.

**Case Description:** We report herein a case in which an unthrombosed large cerebral aneurysm rapidly thrombosed and grew within 3 months after trauma. The highlight in this unusual case was that during surgery, the aneurysm and anterior skull base were adherent and some blood vessels bridged between the aneurysm and dura mater. Histologically, intramural hemorrhage was seen in the tunica media of the aneurysm.

**Conclusion:** Trauma may act as a “second hit” causing adhesion between IAs and surrounding tissues, accelerating inflammation of the vasa vasorum and aneurysmal walls, and thrombosis in IAs.

**Keywords:** Intracranial aneurysm, Large aneurysm, Thrombosed aneurysm, Trauma, Vasa vasorum

## INTRODUCTION

Thrombosed intracranial aneurysms (IAs) are often found only once they have already become relatively large.<sup>[16]</sup> No reports appear to have described IAs in which thrombosis accelerated after trauma. We present herein a rare case of large unthrombosed anterior cerebral aneurysm that rapidly thrombosed and displayed aggravated mass effects after trauma and discuss the mechanisms of thrombosis in IAs.

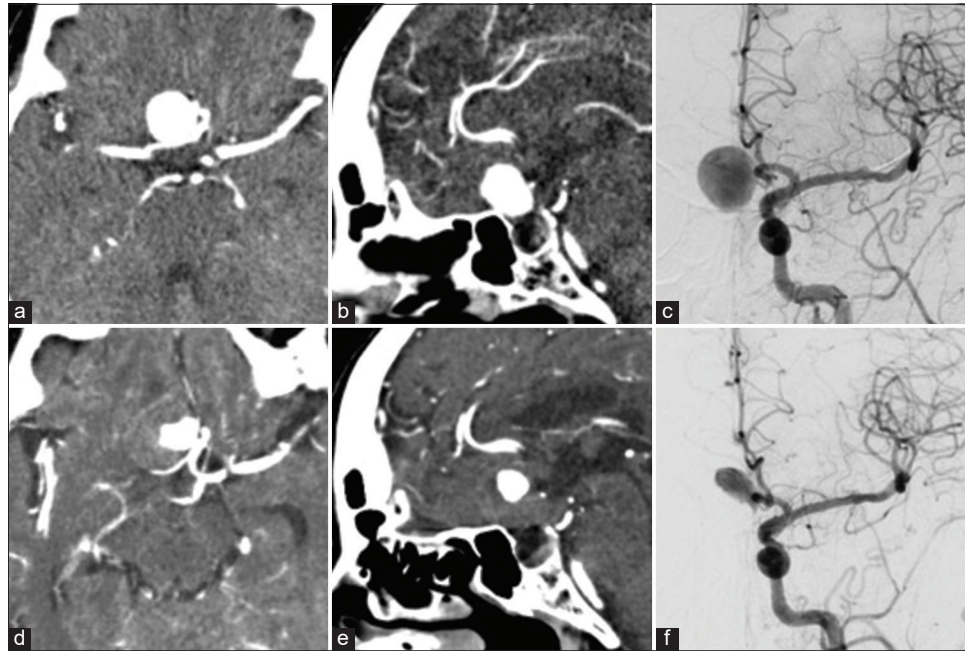
## CASE REPORT

### History and examination

A 78-year-old woman was admitted to our hospital due to a traffic accident, presenting with mild traumatic brain injury, neck pain, rib fracture, and lumbar fracture. Computed tomography (CT) of the head revealed no traumatic lesions such as skull fracture, subarachnoid hemorrhage, or brain contusion, but a 19 mm mass lesion was identified at the base of the right frontal lobe. CT angiography and digital subtraction angiography (DSA) revealed a right anterior cerebral artery aneurysm with a dome measuring 19.0 × 14.7 mm and a neck 4.7 mm in diameter [Figure 1a, b and c]. Neurological

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**Figure 1:** Radiological examinations on presentation and at the 3-month follow-up. The initial computed tomography (CT) shows aneurysm at the base of the anterior fossa with homogeneous enhancement on axial view (a) and sagittal view (b). Digital subtraction angiography (DSA) shows cerebral aneurysm of the right anterior cerebral artery (proximal A2 portion) on the left angiography (c). CT at the 3-month follow-up shows that the aneurysm has grown and is partially thrombosed on contrast-enhanced CT (d and e) and DSA (f).

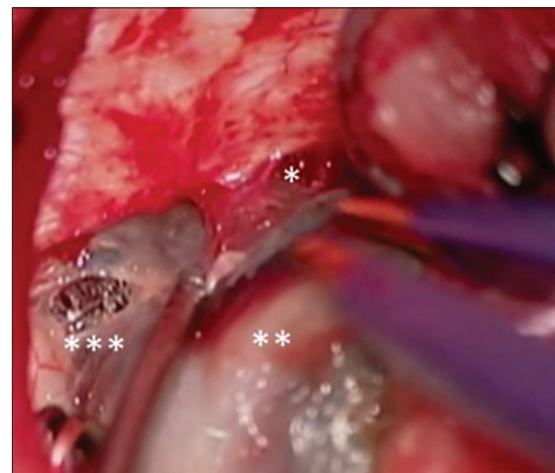
examination showed no signs of ocular symptoms. Three months later, she was readmitted to our hospital due to progressive right visual field defect and cognitive impairment. The right visual acuity had decreased significantly (from 0.3 to 0.01) compared to 3 months earlier, and only the paracentral region of the visual field was preserved. Contrast-enhanced CT, magnetic resonance (MR) imaging, and DSA revealed that the aneurysm had grown to  $24.0 \times 20.7$  mm and was partially thrombosed, and also showed edema of the optic chiasm/tract and frontal lobe, and ischemia of the perforator area. The aneurysmal wall was slightly enhanced [Figure 1d, e and f].

### Operation

The aneurysm was approached under an interhemispheric approach. Since the aneurysm was hard and could not be directly clipped due to thrombosis, A3-A3 *in situ* bypass and trapping were performed. The anteroinferior part of the aneurysm was adherent to the anterior skull base, and multiple microvessels were seen bridging between the aneurysm wall and dura mater [Figure 2]. After the bypass and trapping procedure, the thrombus was partially dissected to reduce pressure on the optic structures.

### Histology of the aneurysm

Endothelial cells and the internal elastic lamina of the aneurysm had partially disappeared, the media were thick and the smooth muscle layer had degenerated and

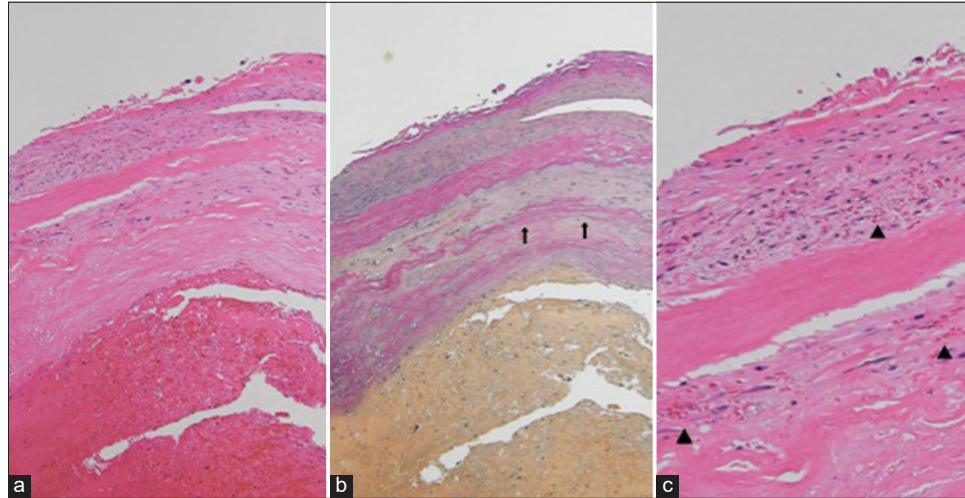


**Figure 2:** Intraoperative view shows small arteries in the adhesion between the aneurysm and frontal base (asterisk). \*\*Aneurysm; \*\*\*arachnoid membrane crossing the chiasmatic cistern.

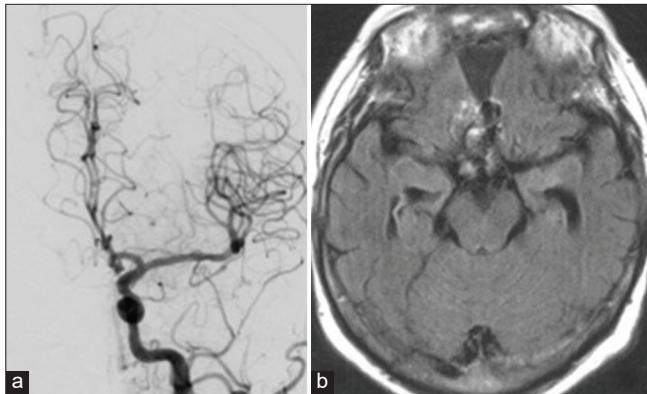
disappeared in parts. Intramural hemorrhage was identified on the outside of the tunica media [Figure 3].

### Postoperative course

The aneurysm was not apparent on DSA and showed reduced volume on MR imaging [Figure 4]. Unfortunately, no neurological improvements were achieved, and she was discharged to rehabilitation.



**Figure 3:** Hematoxylin and eosin (HE) staining shows a thickened aneurysmal wall and organized clot (a). EVG stain shows poorly formed internal elastic lamina (arrow) (b). HE staining shows multiple erythrocytes in the tunica media (arrowhead) (c). Original magnification  $\times 40$  (a and b) and  $\times 100$  (c).



**Figure 4:** Postoperative radiological examination. Digital subtraction angiography (a) and axial fluid-attenuated inversion recovery magnetic resonance imaging (b) show no filling aneurysm.

## DISCUSSION

One of the factors influencing thrombosis in unthrombosed IAs is the form of the aneurysm. As the aspect ratio (depth/neck width) increases, the internal blood flow inside is slowed, and thrombus is thus more likely to form in the IA.<sup>[15]</sup> Thrombosed IAs show changes to hemodynamics within the aneurysm, further promoting the degeneration and remodeling of the aneurysmal wall.<sup>[1,3,4,6-8,10,13,17]</sup> The aneurysm in this case was not thrombosed at the time of discovery, but the conditions (large size, aspect ratio, and unbalanced intraluminal flow) were considered likely to cause thrombus in the aneurysm. Nevertheless, the trauma may have acted as a “second hit” to cause increased thrombus within the relatively short time of 3 months.

The highlight in this unusual case was that during surgery, the aneurysm and dura mater were adherent and some

bridging blood vessels were identified between the two. Regarding the relationship between thrombosed cerebral aneurysms and the vasa vasorum, few reports have examined the mechanisms of aneurysm growth with interrupted blood circulation.<sup>[5,10]</sup> Large IAs are known to develop thrombus even in areas where the vasa vasorum is originally poor (anterior/middle/posterior cerebral artery).<sup>[2,9,11,12,14]</sup> In addition, the effects of contrast enhancement and peripheral edema on the aneurysm wall reflect inflammatory conditions.<sup>[8]</sup> Those reports show that giant thrombosed aneurysm adheres to surrounding brain tissue to promote inflammatory conditions and the aneurysm wall itself thickens. In this case, the bottom of the aneurysm touched against the anterior skull base and the dome of the aneurysm was attached to the surrounding frontal lobe at the time of discovery. No signs of trauma (subarachnoid hemorrhage, subdural hematoma, or brain contusion) were apparent on first radiological examinations, but mild traumatic brain injury as in this presentation may have changed and aggravated the inflammatory conditions between the aneurysm and adhered surrounding tissues (brain, optic chiasm, optic cord, and skull base), promoting the development of vasa vasorum and intramural hemorrhage, and accelerating thrombosis and growth of the aneurysm.

A key limitation in this study was the lack of ways to determine whether neovessels had been present between the aneurysm and dura of the skull base before trauma. As this report only examined a single case, further studies of larger cohorts are still needed.

## CONCLUSION

Trauma may promote thrombosis and growth of IAs by accelerating inflammatory conditions of the aneurysmal walls.

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## Declaration of patient consent

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

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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