



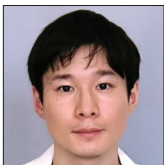
## Case Report

# Spontaneous disappearance of a small unruptured cerebral aneurysm in the clinoid segment of the internal carotid artery: A case report and literature review

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## ABSTRACT

**Background:** Various degrees of thrombosis have been reported in patients with giant aneurysms. However, small, unruptured aneurysms rarely resolve spontaneously. Herein, we report a case of a small unruptured aneurysm in the clinoid segment (C3) of the left internal carotid artery (ICA) that showed almost complete occlusion at the 1-year follow-up.

**Case Description:** A 66-year-old woman developed a subarachnoid hemorrhage on the left side of the perimesencephalic cistern. Cerebral angiography performed on admission revealed no evidence of hemorrhage. Subsequent cerebral angiography on day 12 revealed a dissecting aneurysm on a branch of the superior cerebellar artery (SCA), and the patient underwent parental artery occlusion with 25% n-butyl-2-cyanoacrylate. The postoperative course was uneventful, and the patient was discharged on day 22 with a modified Rankin Scale score of 1. The 1 year follow-up cerebral angiogram demonstrated that the dissecting aneurysm in the SCA branch remained occluded. Notably, a small 2-mm unruptured aneurysm in the clinoid segment (C3) of the left ICA, which was present at the onset of subarachnoid hemorrhage, was almost completely occluded without intervention. Magnetic resonance angiography 1 year after spontaneous resolution of the aneurysm showed no apparent recurrence.

**Conclusion:** This case highlights that even small, unruptured aneurysms can develop spontaneous occlusions.

**Keywords:** Small aneurysm, Spontaneous disappearance, Thrombosis, Unruptured cerebral aneurysm

## INTRODUCTION

Intracranial aneurysms can partially or completely disappear on neuroimaging studies due to thrombosis.<sup>[6,7]</sup> In giant aneurysms, various degrees of thrombosis have been reported to occur in 50% of cases, with the rate of complete occlusion ranging from 13% to 20%.<sup>[17]</sup> The mechanism of this phenomenon is thought to involve slow and disturbed blood flow within the aneurysmal sac, which causes blood stagnation, resulting in thrombosis.<sup>[4,5]</sup> In contrast, unruptured non-giant aneurysms rarely resolve spontaneously.<sup>[1,4,5,16,18,19]</sup> Herein, we report a case of a small unruptured aneurysm in the clinoid segment (C3) of the left internal carotid artery (ICA) that showed almost complete occlusion without any intervention at the year follow-up.

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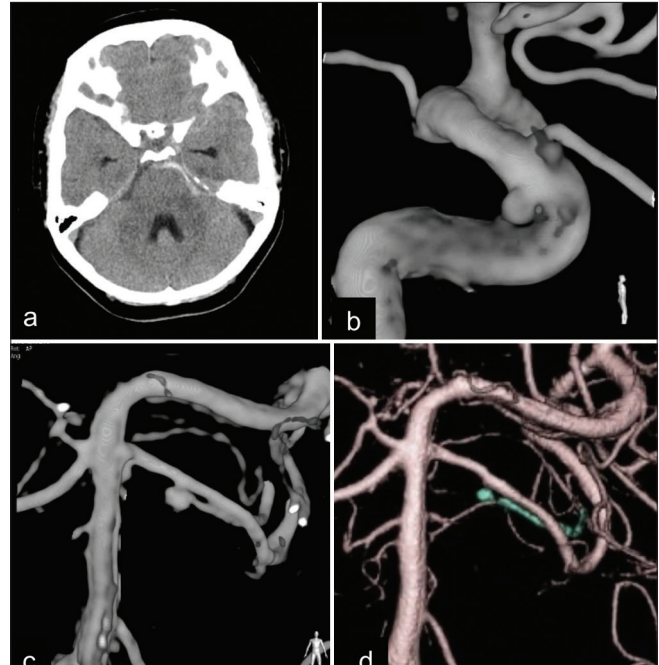
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## CASE REPORT

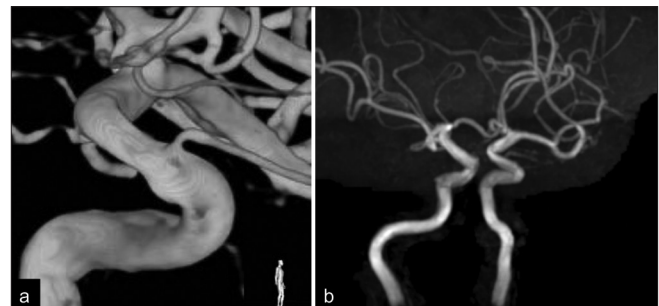
A 66-year-old woman without a notable medical history was brought to her primary physician with a sudden onset of occipital pain while swimming. She was referred to our hospital after a computed tomography (CT) scan showed a subarachnoid hemorrhage on the left side of the perimesencephalic cistern [Figure 1a]. On admission, she was alert with no neurological deficits such as hemiplegia. Blood tests revealed no abnormalities in coagulation. Digital subtraction angiography (DSA) performed on the same day revealed an aneurysm measuring 1.9 mm at the neck and 2 mm deep in the clinoid segment of the left ICA [Figure 1b]. However, other sources of hemorrhage were suspected due to the inconsistency in hematoma distribution and site of the aneurysm, in addition to its oval shape. On day 12 after onset, subsequent DSA revealed no morphological changes in the ICA aneurysm, and angiographic vasospasm was not apparent. However, a dissecting aneurysm measuring 2 mm was found on a branch of the left superior cerebellar artery (SCA), which was thought to be the source of the bleeding, and parent artery occlusion was performed urgently with 25% n-butyl-2-cyanoacrylate [Figure 1c and d]. Magnetic resonance imaging (MRI) the next day showed scattered infarcts in the left SCA region, but the postoperative course was favorable. She was discharged with a modified Rankin scale score of 1 on day 22 after the onset. Follow-up DSA performed 1 year after endovascular treatment showed no recurrence of the dissecting aneurysm in the SCA. Notably, although the aneurysm of the left ICA was untreated, spontaneous, almost complete occlusion was achieved, with a slight bulge remaining at its neck [Figure 2a]. Magnetic resonance angiography 1 year after the disappearance of the aneurysm showed no apparent recurrence [Figure 2b].

## DISCUSSION

Spontaneous resolution of cerebral aneurysms is common in ruptured aneurysms,<sup>[7]</sup> dissecting aneurysms,<sup>[20]</sup> giant aneurysms,<sup>[7]</sup> traumatic aneurysms,<sup>[9]</sup> mycotic aneurysms,<sup>[2]</sup> revascularization surgery for Moyamoya disease,<sup>[11]</sup> treatment of arteriovenous malformation,<sup>[13]</sup> and flow alteration for aneurysms,<sup>[15]</sup> but rarely occurs in small unruptured aneurysms.<sup>[1,4,5,16,18,19]</sup> The main etiology is thought to be thrombosis, and it is well known to occur in giant aneurysms. Thrombosis is associated with the morphological features of giant aneurysms with large dome volumes and narrow necks.<sup>[7,16]</sup> It is thought that slow and turbulent blood flow induces blood flow stagnation, leading to thrombosis. Computational fluid dynamics demonstrated the existence of a shear-rate threshold below which a thrombus could form within the aneurysm.<sup>[14,16]</sup> Thrombosis is also relatively common in ruptured aneurysms, and complete thrombosis occurs in 1–2% of cases.<sup>[8]</sup> The mechanism can be related to hypotension, vasospasm, and damage to the arterial



**Figure 1:** (a) Computed tomography scan on admission showing subarachnoid haemorrhage on the left side of the perimesencephalic cistern. (b) Three-dimensional digital subtraction angiography (3D-DSA) performed on admission showing a saccular aneurysm measuring 1.9 mm at the neck and 2 mm in depth in the left internal carotid artery (ICA). (c and d) 3D-DSA on day 12 before and after parent artery occlusion with 25% n-butyl-2-cyanoacrylate performed for a dissecting aneurysm in the branch of the left superior cerebellar artery.



**Figure 2:** (a) One year follow-up three-dimensional digital subtraction angiography showing spontaneous, almost complete occlusion of the Internal carotid artery (ICA) aneurysm with a slight bulge remaining at its neck. (b) Magnetic resonance angiography one year after disappearance of the aneurysm showing no apparent recurrence.

walls.<sup>[7]</sup> Other etiologies proposed to cause thrombosis include intimal injury due to intra-aneurysmal turbulent flow, hemodynamic changes in the parent artery, and increased coagulability.<sup>[7]</sup>

However, the spontaneous disappearance of small unruptured aneurysms is rare, and the underlying mechanism has not been clarified. Despite the lack of configuration features

that predispose patients to thrombus formation, ischemic events have been reported in small unruptured saccular aneurysms, and distal clot embolization from the aneurysmal sac is the most common mechanism.<sup>[6]</sup> This fact suggests that thrombosis is associated with the radiological disappearance of small, unruptured aneurysms.<sup>[1,5]</sup> To the best of our knowledge, eight cases of the spontaneous disappearance of unruptured aneurysms, including our case, have been reported [Table 1].<sup>[1,4,5,16,18,19]</sup> Seven of the eight were anterior circulation aneurysms, consistent with the characteristics of complete spontaneous thrombosis in unruptured non-small aneurysms.<sup>[16]</sup> Classifying these small aneurysms based on their position within the cerebral vasculature,<sup>[3]</sup> six were sidewall type, and two were bifurcation type. The most common site was the clinoid segment of the ICA in three cases, all of which were classified as the side-wall type.<sup>[18,19]</sup> A study of computational fluid dynamics using 10 mm diameter porous media modeling demonstrated that bifurcation-type aneurysms have great variation in intra-aneurysmal flow and require a higher volume embolization rate to achieve a given volume of stagnant flow during coiling procedures when this type of aneurysm is more oblique to the parent artery.<sup>[12]</sup> On the other hand, the volume embolization rate was independent of the aneurysm angle for side-wall type counterparts.<sup>[12]</sup> Bifurcation-type aneurysms may be less prone to thrombosis, and these results may also apply to small aneurysms.

The interval between the identification and disappearance of small aneurysms ranges from 1 to 15 years, and the degree of disappearance varies.<sup>[1,4,5,16,18,19]</sup> According to Choi *et al.* and Begley *et al.*,<sup>[4,5]</sup> small unruptured aneurysms disappeared only partially, and Yokoya *et al.* reported the disappearance of a small unruptured aneurysm in the C3 segment of the ICA; however, three-dimensional DSA revealed that a slight bulge of the aneurysmal neck remained, as observed in the present case.<sup>[19]</sup> Moreover, Akimoto *et al.* reported that small unruptured aneurysms of the distal anterior cerebral artery regressed and eventually disappeared over 5 years.<sup>[1]</sup> In our case, magnetic resonance angiography was performed 6 months after diagnosis of the aneurysm; however, due to its small size, morphological changes over time could not be assessed.

Yamada *et al.* showed the spontaneous disappearance of small unruptured aneurysms in the clinoid segment of the ICA with intra-aneurysmal T2 high intensity, suggesting thrombosis.<sup>[18]</sup> Neuroimaging features of thrombotic aneurysms are characterized by various high densities within the aneurysms on CT and heterogeneous T1 and T2 signals on MRI, representing differences in the timing of thrombus formation.<sup>[10]</sup> However, in small thrombotic aneurysms, these features may be missed due to imaging resolution issues. In our case, the aneurysm was too

**Table 1:** Summary of cases of spontaneous disappearance of small unruptured cerebral aneurysms.

S. No.	Author, year	Age (years), gender	Location	Side-wall or bifurcation type	Morphology	Duration until disappearance	Status of obliteration	Follow-up period after disappearance	Recurrence
1.	Yamada <i>et al.</i> , 2010 <sup>[18]</sup>	70, F	ICA C3	Side-wall	3 mm in diameter	19 months	Complete disappearance	N/A	N/A
2.	Choi <i>et al.</i> , 2012 <sup>[5]</sup>	69, M	MCA	Bifurcation	4.5 mm in diameter	3 years	Partial disappearance	N/A	N/A
3.	Akimoto <i>et al.</i> , 2020 <sup>[1]</sup>	64, F	distal ACA	Side-wall	4.9 mm in diameter	5 years	Complete disappearance	2 years	Yes
4.	Akimoto <i>et al.</i> , 2020 <sup>[1]</sup>	57, F	M1-M2 bifurcation	Bifurcation	2.4 mm in diameter	13 years	Complete disappearance	N/A	N/A
5.	Vandenbulcke <i>et al.</i> , 2021 <sup>[16]</sup>	73, F	ICA PcomA	side-wall	2.5 mm at the dome, 1.6 mm at the neck	54 months	Almost complete disappearance	4 months	No
6.	Yokoya <i>et al.</i> , 2020 <sup>[19]</sup>	53, F	ICA C3	Side-wall	2.96 mm at neck, 4.08 mm in depth	12 years	Almost complete disappearance	N/A	N/A
7.	Begley <i>et al.</i> , 2023 <sup>[4]</sup>	65, F	P1	Side-wall	4.2x2.4 mm in diameter	15 years	Partial disappearance	N/A	N/A
8.	Present case	66, F	ICA C3	Side-wall	1.9 mm at neck, 2 mm at depth	1 year	Almost complete disappearance	1 year	No

F: Female; M: Male; ICA: Internal carotid artery, MCA: Middle cerebral artery, ACA: Anterior cerebral artery, PcomA: Posterior communicating artery, P1, Precommunicating segment, N/A: Not available

small for CT and MRI to show any findings indicating a thrombus. However, it could still be a thrombosed aneurysm.

There is no consensus regarding the management of small thrombotic aneurysms. Vandembulcke *et al.* reported that none of the 13 (0%) thrombotic aneurysms measuring <10 mm ruptured, although one of 6 (17%) measuring 10-20 mm and 2 (100%) larger than 20 mm thrombotic aneurysms ruptured, and that aneurysm size was the factor predicting rupture.<sup>[6]</sup> The risk of rupture is low in small thrombotic aneurysms, whereas large or giant thrombotic aneurysms are at risk of rupture, and therapeutic intervention is recommended. However, even small thrombotic aneurysms can cause ischemic events.<sup>[6,7]</sup> According to Cohen *et al.*, ischemic events due to small thrombotic aneurysms occurred in 3 of 4000 stroke patients (0.075%).<sup>[6]</sup> Although small thrombosed aneurysms often have a low thrombus volume, resulting in a good neurological prognosis, antiplatelet therapy is recommended to prevent recurrent ischemic events.<sup>[6,16]</sup>

In addition, Akimoto *et al.* reported a small unruptured aneurysm of the distal anterior cerebral artery that completely occluded spontaneously but recurred 2 years later,<sup>[1]</sup> linking it to a potential risk of recanalization in thrombosed aneurysms.<sup>[16]</sup> Long-term follow-up is required even if the spontaneous disappearance of small unruptured aneurysms is observed.

## CONCLUSION

Here, we report the spontaneous disappearance of a small unruptured aneurysm in the clinoid segment of the ICA. The etiology of this phenomenon has not yet been elucidated. However, neuroimaging findings suggested that this may be related to thrombosis. Long-term follow-up is required due to the potential risk of recanalization and ischemic stroke, in addition to clarifying the etiology.

## Ethical approval

The Institutional Review Board approval is not required.

## 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.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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