Ruptured Distal Anterior Choroidal Artery Aneurysm Presenting as Isolated Intraventricular Hemorrhage: Case Report and Comprehensive Review of the Literature

Abstract
Distal anterior choroidal artery (AChA) aneurysms are infrequent. We discuss the case of a 59-year-old patient who presented with an isolated intraventricular hemorrhage (IVH) secondary to a ruptured distal AChA aneurysm. Initial noninvasive cerebral computed tomography angiography revealed no evidence of an underlying vascular pathology. The patient underwent further digital subtraction cerebral angiography, which revealed an aneurysm arising from the distal AChA segment. The aneurysm was successfully treated with surgical clip ligation. The current study highlights the importance of considering a ruptured distal AChA aneurysm as a potential source of isolated IVH.

Keywords: Distal anterior choroidal artery aneurysm, intraventricular aneurysm, intraventricular hemorrhage

Introduction
Intraventricular hemorrhage (IVH) in adults often presents as an extension of aneurysmal subarachnoid hemorrhage or hypertensive intracerebral hemorrhage. In cases of isolated IVH, consideration needs to be given to intraventricular pathologies such as tumors or vascular malformations. An aneurysm arising from the distal anterior choroidal artery (AChA) can be a potential source of spontaneous IVH, even with negative initial noninvasive angiography.

We report a case of isolated IVH secondary to a ruptured true distal AChA aneurysm of idiopathic origin that was successfully treated with surgical clip repair. A comprehensive literature review was performed to underscore the importance of considering distal AChA aneurysm as a potential underlying cause of isolated IVH.

Case Report
A 59-year-old female presented with severe occipital headache, vomiting, and confusion over 3 days. Clinical examination did not demonstrate any focal neurological deficit. Cerebral computed tomography (CT) revealed isolated IVH [Figure 1] and subsequent CT angiography and magnetic resonance angiography (MRA) did not reveal a potential source of hemorrhage. Selective right internal carotid artery (ICA) digital subtraction angiography (DSA) demonstrated a 4 mm aneurysm arising from the intraventricular segment of the distal right AChA [Figure 2a], adjacent to the known intraventricular hematoma.

The patient underwent a right temporal craniotomy and clipping of the aneurysm. A right middle temporal gyrus approach was performed to gain access into the temporal horn of the lateral ventricle. The intraventricular hematoma was carefully evacuated. Under stereotactic image guidance, the aneurysm was localized and then obliterated with a 5 mm angled Sugita aneurysm clip. Patency of the proximal and distal segment of the AChA was confirmed with intraoperative micro-Doppler ultrasound, and the aneurysm was resected. The patient recovered well following the surgery without neurological deficit. Postoperative DSA had demonstrated no evidence of residual aneurysm [Figure 2b]. Histopathological evaluation confirmed a true saccular intracranial aneurysm [Figure 3]. She remained well at 12-month follow-up.

Discussion
AChA aneurysms are uncommon and account for 2%–5% of all intracranial

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Tan, et al.: Ruptured distal anterior choroidal artery aneurysm

They commonly originate along the proximal segment of AChA, near its junction with the supraclinoid ICA. Distal AChA aneurysms are rare and originate from the intraventricular portion of AChA. To date, only thirty cases of ruptured intraventricular distal AChA aneurysms have been reported in the English literature. Previously published articles have reported a high incidence of negative initial angiography. This may be explained by the small size rendering visualization on conventional imaging difficult due to overlapping adjacent vessels. The aneurysm, in this case, was not detected on initial CT and MRA but was subsequently identified on conventional DSA due to strong clinical suspicion.

Our literature analysis highlighted that ruptured distal AChA aneurysm affects patients across a wide age group that ranges from 8 to 84 years old [Table 1]. Peak age of incidence was noted between 30 and 70 years (mean 45 years). Females were more commonly affected (female: male = 2.4:1). The size at which the aneurysms had ruptured was small (mean 4 mm; range 2–7 mm). The aneurysms were associated with various clinical conditions including Moyamoya disease (15 cases), idiopathic (ten cases), atherosclerosis (three cases), cerebral arteriovenous malformation (one case), trauma (one case), and iatrogenic (one case). Ruptured aneurysms arising from the intraventricular segment of AChA frequently result in extension of hematoma into the subarachnoid space (35%) and adjacent parenchyma (23%). However, isolated IVH has been reported in 15 cases previously.

The treatment of AChA aneurysms is not without significant morbidity. Injury to AChA can lead to severe neurological deficits including contralateral hemiplegia, hemianesthesia, and homonymous hemianopsia. Before the 1990s, many cases of ruptured distal AChA aneurysms were treated conservatively. Of these, 60% resulted in death due to progressive clinical deterioration or rebleeds. Since then, many distal AChA aneurysms have been actively managed by a variety of therapeutic modalities. Out of thirty cases reported in the literature, 13 were treated with open microsurgery, five through endovascular procedure, and one through an endoscopic approach. With the establishment of microsurgical techniques, surgical clip ligation has been utilized with good outcomes. In recent years, a number of ruptured distal AChA aneurysm cases have been successfully treated with endovascular techniques.

**Conclusion**

The current study reports a case of ruptured distal AChA aneurysm presenting as isolated IVH and emphasizes the need for further invasive cerebral DSA when initial noninvasive vascular imaging modalities are negative. This study underscores the importance of clinical suspicion and early surgical or endovascular repair of these aneurysms to optimize clinical outcome.

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| Case | Author/year | Age | Gender | Presentations | Diagnosis | Etiology | Side | Size (mm) | Treatment | Histology | Outcome |
|------|-------------|-----|--------|---------------|-----------|----------|------|-----------|-----------|-----------|---------|
| 1    | Cressman and Hayes 1966⁴ | 34  | Male   | ICH, SAH, IVH | DSA       | Traumatic | Left | -         | Conservative | -         | Death from ruptured aneurysm |
| 2    | Butler et al., 1972⁵ | 15  | Female | ICH, SAH, IVH | DSA       | Idiopathic | Left | -         | Clipping    | Cluster of abnormal blood vessels |
| 3    | Papo et al., 1973⁶ | 57  | Female | SAH, IVH      | DSA       | Atherosclerosis | Right | -         | Excision    | False aneurysm |
| 4    | Takahashi 1980⁶⁷ | 59  | Male   | SAH          | DSA       | Moyamoya | Left  | 3.5       | Unknown    | -         | Death from ruptured aneurysm |
| 5    | Tanaka et al., 1980⁸ | 57  | Female | SAH           | DSA       | Moyamoya | Right | -         | Conservative | -         | Death from ruptured aneurysm |
| 6    | Konishi et al., 1985⁹⁰ | 18  | Female | SAH          | DSA       | Moyamoya | Right | 6         | Conservative | -         | Death from ruptured aneurysm |
| 7    | Konishi et al. | 13  | Male   | IVH           | DSA       | Moyamoya | Right | 3         | Conservative | -         | Death from ruptured aneurysm |
| 8    | - | 57  | Female | IVH           | DSA       | Moyamoya | Right | 2         | Conservative | -         | Death from ruptured aneurysm |
| 9    | - | 34  | Female | IVH              | DSA       | Moyamoya | Right | 3         | Conservative | -         | Death from ruptured aneurysm |
| 10   | Knuckey et al., 1988⁹¹ | 46  | Female | SAH, IVH     | DSA       | Atherosclerosis | Left | -         | Excision    | Degenerative arterial wall with intramural thrombus |
| 11   | Inagawa et al., 1990¹⁰ | 75  | Female | IVH, SAH     | DSA       | Idiopathic | Right | 5         | Conservative | True aneurysm | Death from pulmonary artery thrombosis |
| 12   | Nishihara et al., 1993¹¹ | 34  | Female | IVH, SAH     | DSA       | Idiopathic | Right | 4         | Clipping    | True aneurysm | No deficit |
| 13   | Hamada et al., 1994¹² | 48  | Female | IVH           | DSA       | Moyamoya | Left  | -         | Clipping of parent artery | True aneurysm | Initial transient right hemiparesis, no deficit at discharge |
| 14   | Kawai et al., 1997¹³ | 19  | Male   | IVH           | DSA       | Moyamoya | Right | -         | Conservative | -         | Persistent left-hand clumsiness |
| 15   | Yoneoka et al., 1998¹⁴ | 69  | Male   | IVH           | DSA       | Idiopathic | Right | 5         | Clipping    | True aneurysm | Bedridden |
| 16   | Yanaka et al., 2000¹⁵ | 8   | Female | IVH           | DSA       | AVM      | Right | 4         | Excision    | True aneurysm | No deficit |
| 17   | Lee et al., 2001¹⁶ | 48  | Male   | ICH, IVH     | DSA       | Moyamoya | Right | -         | Trapping and resection | True aneurysm | No deficit |
| 18   | Wong et al., 2003¹⁷ | 62  | Female | ICH, IVH     | DSA       | Moyamoya | Right | -         | Clipping    | -         | Persistent left hemiparesis |
| 19   | Inci et al., 2007¹⁸ | 19  | Female | ICH, IVH     | CTA       | Idiopathic | Right | 4         | Trapping and resection | True aneurysm | No deficit |

Contd...
Table 1: Contd...

| Case | Author/year | Age | Gender | Presentations | Diagnosis | Etiology | Side | Size (mm) | Treatment | Histology | Outcome |
|------|-------------|-----|--------|--------------|-----------|----------|------|-----------|-----------|-----------|---------|
| 20   | -           | 37  | Female | ICH, IVH, SAH | DSA       | Idiopathic | Left | -         | Aneurysm accidentally aspirated during open surgery | - | Death from diffuse vasospasm |
| 21   | Pavesi et al., 2008[18] | 54  | Female | IVH | DSA | Idiopathic | Left | - | Trapping and resection | True aneurysm | Glasgow Outcome Scale 4 |
| 22   | Yurt et al., 2009[19] | 70  | Male | ICH, IVH | MRA | Idiopathic | Right | - | Clipping | - | No deficit |
| 23   | Kim et al., 2009[20] | 43  | Female | IVH | DSA | Moyamoya | Left | - | Endovascular embolization with nBCA/lipiodol | - | Partial recovery from initial neurological deficit |
| 24   | Choulakian et al., 2010[21] | 35  | Female | SAH, IVH | CTA | Moyamoya | Left | 4.5 | Endovascular embolization with nBCA/ethiodol | - | No deficit |
| 25   | Yang et al., 2010[22] | 38  | Female | IVH | DSA | Moyamoya | Left | 5 | Endovascular embolization with Glubran 2/lipiodol | - | No deficit |
| 26   | Lévéque et al., 2011[23] | 50  | Female | IVH | MRA | Moyamoya | Left | 7 | Endoscopic excision | True aneurysm | No deficit |
| 27   | Nishida et al., 2011[24] | 84  | Female | IVH | DSA | Atherosclerosis | Left | 6 | Endovascular embolization with platinum coils | - | Slight sensory aphasia from left parieto-occipital infarction, no new deficit |
| 28   | Dolati et al., 2012[1] | 55  | Male | IVH | DSA | PCA occlusion | Right | 2.5 | Endovascular embolization with glue | - | Persistent left hemiparesis |
| 29   | Yuan et al., 2013[25] | 46  | Male | IVH | CTA | Idiopathic | Left | 3 | Conservative | - | Death from rebleeding 9 months later |
| 30   | -           | 45  | Female | IVH | CTA | Moyamoya | Right | 4 | Conservative | - | No deficit |
| 31   | Present case, 2016 | 59  | Female | IVH | DSA | Idiopathic | Right | 4 | Clipping | True aneurysm | No deficit |

ICH – Intracerebral hemorrhage; IVH – Intraventricular hemorrhage; SAH – Subarachnoid hemorrhage; AVM – Arteriovenous malformation; PCA – Posterior cerebral artery; nBCA – n-butyl cyanoacrylic acid; DSA – Diagnostic cerebral angiography; CTA – Computed tomography angiography; MRA – Magnetic resonance angiography
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Conflicts of interest
There are no conflicts of interest.

References
1. Dolati P, Sutherland G, Wong J, Hudon M, Goyal M. Distal anterior choroidal artery aneurysm following iatrogenic posterior cerebral artery occlusion: A case report and review of literature. Acta Neurochir (Wien) 2012;154:53-7.
2. Inci S, Arat A, Ozgen T. Distal anterior choroidal artery aneurysms. Surg Neurol 2007;67:46-52.
3. Cressman MR, Hayes GJ. Traumatic aneurysm of the anterior choroidal artery. Case report. J Neurosurg 1966;24:102-4.
4. Butler AB, Partain RA, Netsky MG. Primary intraventricular hemorrhage. A mild and remediable form. Neurology 1972;22:675-87.
5. Papo I, Salvolini U, Caruselli G. Aneurysm of the anterior choroidal artery with intraventricular hematoma and hydrocephalus. Case report. J Neurosurg 1973;39:255-60.
6. Takahashi M. Magnification angiography of cerebral aneurysms associated with Moyamoya disease. AJNR 1980;1:547-50.
7. Tanaka Y, Takeuchi K, Akai K. Intracranial ruptured aneurysm accompanying Moyamoya phenomenon. Acta Neurochir (Wien) 1980;52:35-43.
8. Konishi Y, Kadowaki C, Haru M, Takeuchi K. Aneurysms associated with Moyamoya disease. Neurosurgery 1985;16:484-91.
9. Knuckey NW, Epstein MH, Haas R, Sparadeo F. Distal anterior choroidal artery aneurysm: Intraoperative localization and treatment. Neurosurgery 1988;22(6 Pt 1):1084-7.
10. Inagawa T, Matsuda Y, Kamiya K, Aoyama H, Nagasako R, Yamamoto M. Saccular aneurysm of the distal anterior choroidal artery – Case report. Neurol Med Chir (Tokyo) 1990;30:498-502.
11. Nishihara J, Kuman Y, Matsuo Y, Sakaki S. A case of distal anterior choroidal artery aneurysm: Case report and review of the literature. Neurosurgery 1993;32:834-7.
12. Hamada J, Hashimoto N, Tsukahara T. Moyamoya disease with repeated intraventricular hemorrhage due to aneurysm rupture. Report of two cases. J Neurosurg 1994;80:328-31.
13. Kawai K, Narita K, Nakayama H, Tamura A. Ventricular hemorrhage at an early stage of Moyamoya disease – Case report. Neurol Med Chir (Tokyo) 1997;37:184-7.
14. Yoneoka Y, Ezuka I, Takai N, Oda T, Tamura T, Yamashita S. Ruptured distal anterior choroidal artery aneurysm presenting with casting intraventricular haemorrhage. Acta Neurochir (Wien) 1998;140:185-9.
15. Yanaka K, Tsuboi K, Fujita K, Aoki K, Takeuchi S, Anno I, et al. Distal anterior choroidal artery aneurysm associated with an arteriovenous malformation. Intraoperative localization and treatment. Surg Neurol 2000;53:546-51.
16. Lee JK, Lee JH, Kim SH, Lee MC. Distal anterior choroidal artery aneurysm in a patient with moyamoya disease: Case report. Neurosurgery 2001;48:222-5.
17. Wong GK, Boet R, Poon WS. Ruptured distal anterior choroidal artery aneurysm presenting with right intracerebral haematoma: Clipping aided by subpial uncal resection. J Clin Neurosci 2003;10:689-91.
18. Pavesi G, Amistå P, Munari M, Gardiman MP. Intraventricular hemorrhage caused by peripheral anterior choroidal artery aneurysm rupture. A case report. Neuroradiol J 2008;21:717-20.
19. Yurt A, Turan Y, Uçar K, Camlar M, Oran I. Ruptured distal anterior choroidal artery aneurysm. J Clin Neurosci 2009;16:132-4.
20. Kim SH, Kwon OK, Jung CK, Kang HS, Oh CW, Han MH, et al. Endovascular treatment of ruptured aneurysms or pseudoaneurysms on the collateral vessels in patients with Moyamoya disease. Neurosurgery 2009;65:1000-4.
21. Choulakian A, Drazin D, Alexander MJ. NBCA embolization of a ruptured intraventricular distal anterior choroidal artery aneurysm in a patient with Moyamoya disease. J Neurointerv Surg 2010;2:368-70.
22. Yang S, Yu JL, Wang HL, Wang B, Luo Q. Endovascular embolization of distal anterior choroidal artery aneurysms associated with Moyamoya disease. A report of two cases and a literature review. Interv Neuroradiol 2010;16:433-41.
23. Lévêque M, McLaughlin N, Laroche M, Bojanowski MW. Endoscopic treatment of distal choroidal artery aneurysm. J Neurosurg 2011;114:116-9.
24. Nishida A, Tokunaga K, Hishikawa T, Sugiu K, Date I. Endovascular coil embolization of a ruptured distal anterior choroidal artery aneurysm associated with ipsilateral middle cerebral artery occlusion – Case report. Neurol Med Chir (Tokyo) 2011;51:716-9.
25. Yuan Z, Woha Z, Weiming X. Intraventricular aneurysms: Case reports and review of the literature. Clin Neurol Neurosurg 2013;115:57-64.
26. Lee YS, Park J. Anterior choroidal artery aneurysm surgery: Ischemic complications and clinical outcomes revisited. J Korean Neurosurg Soc 2013;54:86-92.