



# A case of spontaneous subarachnoid hemorrhage and intraventricular hemorrhage with negative computed tomography angiography findings

Po-Chien Hwa<sup>1,2</sup>, Yu-Hui Chiu<sup>1,2,3</sup>, Liong-Rung Liu<sup>1,2</sup>, Wen-Han Chang<sup>1,2</sup>

<sup>1</sup>Department of Emergency Medicine, Mackay Memorial Hospital, Taipei, Taiwan; <sup>2</sup>Department of Medicine, Mackay Medical College, New Taipei City, Taiwan; <sup>3</sup>Department of Emergency, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan

Correspondence to: Dr. Yu-Hui Chiu. Department of Emergency Medicine, Mackay Memorial Hospital, 92, Section 2, Zhongshan North Road, Taipei 10449, Taiwan. Email: yuhui7786@gmail.com; Dr. Liong-Rung Liu. Department of Emergency Medicine, Mackay Memorial Hospital, 92, Section 2, Zhongshan North Road, Taipei 10449, Taiwan. Email: lewis0815@gmail.com.

**Abstract:** Brain computed tomography angiography (CTA) is a useful tool for detecting subarachnoid hemorrhage (SAH) and cerebral aneurysms, but less reliably when cerebral aneurysms which are smaller than 2 mm. We present a case of spontaneous SAH and intraventricular hemorrhage (IVH) with negative findings on brain CTA. Due to the clinical presentation and positive neurologic examination, lumbar puncture was performed and xanthochromia of cerebrospinal fluid (CSF) had been noted. Cerebral angiography was performed and showed a small unruptured saccular cerebral aneurysm (<2 mm).

**Keywords:** Brain computed tomography angiography (CTA); cerebral aneurysm; digital subtraction angiography (DSA); subarachnoid hemorrhage (SAH)

Received: 26 June 2018. Accepted: 05 November 2019; Published: 13 December 2019.

doi: 10.21037/ht.2019.11.02

View this article at: <http://dx.doi.org/10.21037/ht.2019.11.02>

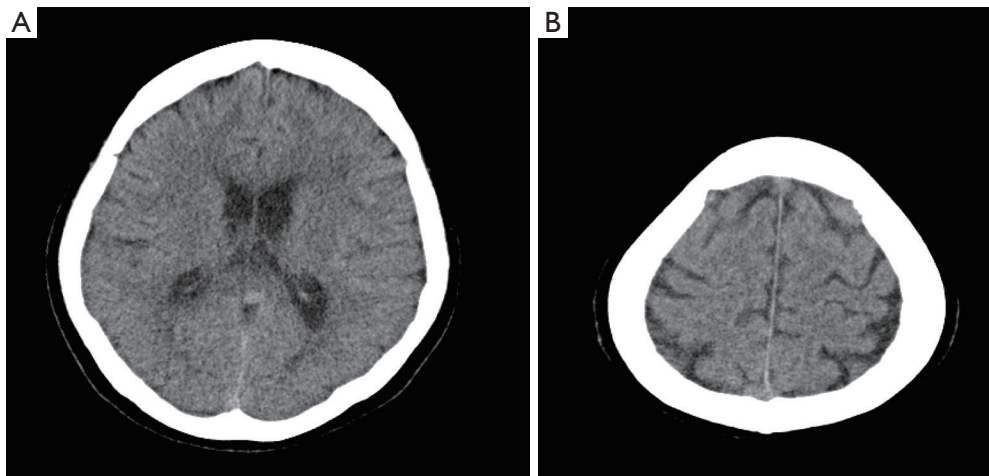
## Introduction

The prevalence of cerebral aneurysms in the general population is approximately 2–3% (1–3) and small ruptured aneurysms <5 mm were found in about 40% of all spontaneous subarachnoid hemorrhage (SAH) patients (4). Although literatures (3,5) demonstrated that small cerebral aneurysms have a low risk of rupture, many experienced neurosurgeons and endovascular therapists report that most ruptured aneurysms encountered in practice are small (6,7). As seen in a study by Gupta *et al.*, aneurysms smaller than 2 mm can also result in an SAH and constituted 7% of ruptured aneurysms (8). We hereby present a mid-aged female patient diagnosed with SAH and intraventricular hemorrhage (IVH) with negative findings on brain computed tomography angiography (CTA), which derived from a tiny cerebral aneurysm. The only clues at the first beginning were stiffness of neck and xanthochromia of cerebrospinal fluid (CSF). This was a rare case based on our experiences without efficient data on the best diagnostic

strategies and emphasized the importance of clinical examination but imaging examination.

## Case presentation

A 53-year-old woman was brought to the emergency department with sudden onset of explosive headache lasting more than 12 h. She had a past medical history of hypertension but didn't take any medication regularly. There was no history of trauma, fever, swallowing problem and vomiting occurred. On neurologic examination, stiff neck and both of the Brudzinski's sign and Kernig's sign were noted, but the laboratory and physical examination were otherwise unremarkable. Brain CT (*Figure 1*) and CTA showed no abnormality. Lumbar puncture was performed, which demonstrated opening pressure 85 mmH<sub>2</sub>O and closing pressure 70 mmH<sub>2</sub>O and revealed turbid and pink CSF fluid on visual inspection. Her CSF analysis demonstrated 127 white blood cells per mm<sup>3</sup> and >10,000 red blood cells per



**Figure 1** Brain computed tomography showed no abnormal density in brain parenchyma.



**Figure 2** Lumbar puncture revealed xanthochromia of CSF in left tube. Normal CSF was in the right tube. CSF, cerebrospinal fluid.

mm<sup>3</sup>, and xanthochromia by spectrophotometry in *Figure 2*. Because of SAH was highly suspected by the clinical history and presentation, digital subtraction angiography (DSA) was performed and showed a small saccular cerebral aneurysm (<2 mm) at ophthalmic segment of left internal carotid artery in *Figure 3*. Brain magnetic resonance imaging (MRI) also revealed SAH and IVH involving bilateral lateral ventricles in *Figure 4*. The patient received conservative treatment and discharged after an uneventful recovery. She has remained well at 6-month follow-up.

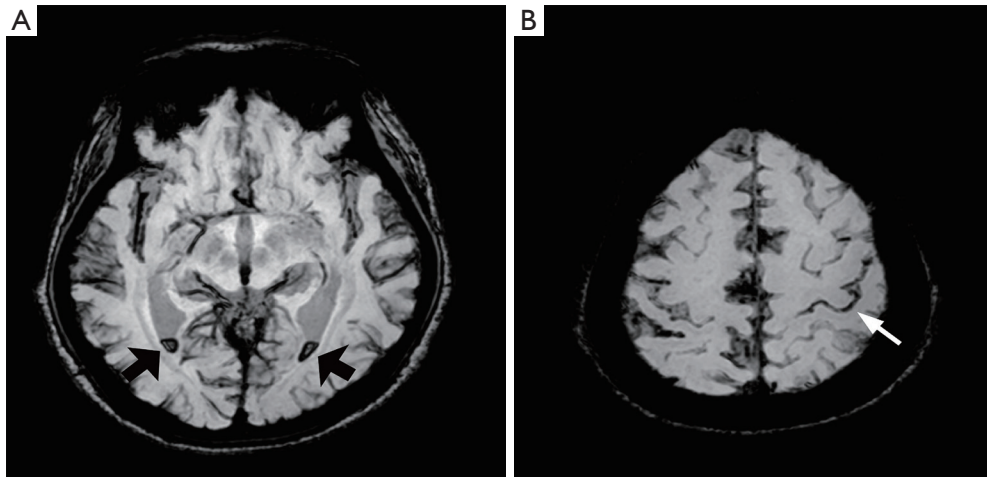
## Discussion

About 80–85% of nontraumatic SAHs are caused by



**Figure 3** Digital subtraction angiography showed a small blister cerebral aneurysm measuring about 1.5 mm arising from cavernous portion of left internal carotid artery.

cerebral aneurysm rupture (2) and late diagnosis of this life-threatening disease will be dangerous. Meningeal signs and xanthochromia of CSF are the typical findings which is easy for physicians to check at the first beginning (9,10). Brain CTA is less invasive than DSA and more convenient for



**Figure 4** BOLD magnetic resonance imaging demonstrated blood layering in bilateral lateral ventricles (black arrows) and subarachnoid hemorrhage over left vertex sulci (white arrow). BOLD, blood oxygen level dependent.

clinical management, but some smaller cerebral aneurysms are undetectable on brain CTA (2,11,12). A study performed by Wintermark *et al.* revealed that brain CTA only had a sensitivity of 50% for aneurysms <2 mm (12,13), though brain CTA has been reported a sensitivity of 97–100% for the detection of intracranial aneurysms in prior studies (9). DSA remains the gold standard for detecting and characterizing intracranial aneurysms, which identifies a cause of SAH in 4–14% of patients with negative brain CTA images (14,15). DSA should be performed based on the clinical picture highly suggestive of SAH (1,2).

Although brain CTA could help us making diagnosis more easily, physicians should be alert to the possibility of SAH even if there was no positive finding on brain CTA. Cerebral aneurysms which are smaller than 2 mm are less reliably detected by brain CTA (15–17). Patients presenting to emergency department with a sudden explosive headache and positive meningeal signs should be treated with caution. It is recommended that DSA should be considered if there is a highly clinical suspicion of SAH.

### Acknowledgments

*Funding:* None.

### Footnote

*Conflicts of Interest:* All authors have completed the ICMJE

uniform disclosure form (available at <http://dx.doi.org/10.21037/ht.2019.11.02>). WHC serves as an Editor-in-Chief of *Health Technology*. The other 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 studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

*Open Access Statement:* This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

### References

1. Grasso G, Alafaci C, Macdonald RL. Management of

- aneurysmal subarachnoid hemorrhage: State of the art and future perspectives. *Surg Neurol Int* 2017;8:11.
2. Yang ZL, Ni QQ, Schoepf UJ, et al. Small Intracranial Aneurysms: Diagnostic Accuracy of CT Angiography. *Radiology* 2017;285:941-52.
  3. Zanaty M, Daou B, Chalouhi N, et al. Evidence That a Subset of Aneurysms Less Than 7 mm Warrant Treatment. *J Am Heart Assoc* 2016;5.
  4. Choi JH, Park HS. The Incidence and Characteristics of Patients with Small Ruptured Aneurysms (<5 mm) in Subarachnoid Hemorrhage. *J Korean Neurosurg Soc* 2017;60:424-32.
  5. Wiebers DO, Whisnant JP, Huston J, 3rd, et al. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. *Lancet* 2003;362:103-10.
  6. Weir B, Disney L, Karrison T. Sizes of ruptured and unruptured aneurysms in relation to their sites and the ages of patients. *J Neurosurg* 2002;96:64-70.
  7. Korja M, Lehto H, Juvela S. Lifelong rupture risk of intracranial aneurysms depends on risk factors: a prospective Finnish cohort study. *Stroke* 2014;45:1958-63.
  8. Gupta V, Chugh M, Jha AN, et al. Coil embolization of very small (2 mm or smaller) berry aneurysms: feasibility and technical issues. *AJNR Am J Neuroradiol* 2009;30:308-14.
  9. Heit JJ, Pastena GT, Nogueira RG, et al. Cerebral Angiography for Evaluation of Patients with CT Angiogram-Negative Subarachnoid Hemorrhage: An 11-Year Experience. *AJNR Am J Neuroradiol* 2016;37:297-304.
  10. Yap L, Dyde RA, Hodgson TJ, et al. Spontaneous subarachnoid hemorrhage and negative initial vascular imaging--should further investigation depend upon the pattern of hemorrhage on the presenting CT? *Acta Neurochir (Wien)* 2015;157:1477-84.
  11. Bechan RS, van Rooij SB, Sprengers ME, et al. CT angiography versus 3D rotational angiography in patients with subarachnoid hemorrhage. *Neuroradiology* 2015;57:1239-46.
  12. Moran CJ. Aneurysmal subarachnoid hemorrhage: DSA versus CT angiography--is the answer available? *Radiology* 2011;258:15-7.
  13. Wintermark M, Uske A, Chalaron M, et al. Multislice computerized tomography angiography in the evaluation of intracranial aneurysms: a comparison with intraarterial digital subtraction angiography. *J Neurosurg* 2003;98:828-36.
  14. Westerlaan HE, Gravendeel J, Fiore D, et al. Multislice CT angiography in the selection of patients with ruptured intracranial aneurysms suitable for clipping or coiling. *Neuroradiology* 2007;49:997-1007.
  15. Philipp LR, McCracken DJ, McCracken CE, et al. Comparison Between CTA and Digital Subtraction Angiography in the Diagnosis of Ruptured Aneurysms. *Neurosurgery* 2017;80:769-77.
  16. Menke J, Larsen J, Kallenberg K. Diagnosing cerebral aneurysms by computed tomographic angiography: meta-analysis. *Ann Neurol* 2011;69:646-54.
  17. Olin JW, Gornik HL, Bacharach JM, et al. Fibromuscular dysplasia: state of the science and critical unanswered questions: a scientific statement from the American Heart Association. *Circulation* 2014;129:1048-78.

doi: 10.21037/ht.2019.11.02

**Cite this article as:** Hwa PC, Chiu YH, Liu LR, Chang WH. A case of spontaneous subarachnoid hemorrhage and intraventricular hemorrhage with negative computed tomography angiography findings. *Health Technol* 2019;3:10.