

Subarachnoid Hemorrhage with Subdural Hematoma due to Ruptured *De Novo* Aneurysm after Aneurysmal Clipping via Pterional Approach: An Autopsy Case

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Received: February 1, 2018
Revised: February 17, 2018
Accepted: February 23, 2018

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Subdural hematoma (SDH) due to spontaneous rupture of intracranial aneurysm rarely occurs. The prevalence of subarachnoid hemorrhage (SAH) with SDH is approximately 0.5%–10.3% of all aneurysmal SAH. We report a case of aneurysmal rupture with SDH and SAH due to arachnoid defect after aneurysm clipping. The decedent was a 51-year-old woman who underwent brain surgery for SAH a few years ago. Two days before she died, she had nausea and sentinel headache. She was alive in the morning and was found dead at 6 PM. Injuries in the external surface were not found. A fresh SDH, measured approximately 90 mL, was found in the right hemisphere. SAH was diffusely distributed at the base of the brain and the right sylvian fissure. Two aneurysmal clippings were found in the anterior communicating artery and right internal carotid artery. A ruptured *de novo* aneurysm was also found in the right proximal middle cerebral artery. An uncal herniation was also observed. The cause of death was SAH with SDH due to *de novo* intracranial aneurysm. The tearing caused by the adhesion between the aneurysm and arachnoid, high blood pressure, and massive bleeding has been thought to be the causative mechanism of aneurysmal SAH with SDH. However, in this case, the arachnoid defect was caused by aneurysmal clipping through pterional approach. This defect served as the passage between the subarachnoid and subdural spaces. The autopsy for recurrent intracranial aneurysm will increase according to the extending life expectancy of patients after aneurysmal clipping.

Key Words: Subarachnoid hemorrhage; Subdural hematoma; Intracranial aneurysm; Autopsy

Introduction

Ruptured intracranial aneurysm usually presents as subarachnoid hemorrhage (SAH), while subdural hematoma (SDH) is mostly caused by trauma. SAH with SDH due to ruptured intracranial aneurysm rarely occurs. In the literature, the prevalence of these cases is approximately 0.5%–10.3% of all aneurysmal SAH cases

[1,2]. This phenomenon was considered to be a result of arachnoid membrane tearing caused by adhesion between the dura mater and arachnoid membrane, high blood pressure, or massive hemorrhage [3]. Hemorrhage is spread to the subdural space through this tearing. However, neurosurgery via pterional approach involves making an arachnoid defect, which works as a passage between the subarachnoid and subdural spaces. We

report a case of SAH with SDH due to arachnoid defect after aneurysmal clipping via pterional approach sustained after the rupture of intracranial aneurysm.

Case Report

The decedent was a 51-year-old woman, 155 cm tall and weighing 51 kg. A few years ago, she underwent brain surgery, i.e., aneurysmal clipping. She had taken hypertensive medications. She used to smoke and drink. Two days before she died, she had nausea and sentinel headache. On the day of her death, her husband saw her alive in the morning. At 6 PM, he found her dead in front of the bathroom. Her pants were taken off. There was no evidence of anyone invading the house of the decedent. During the external examination, injuries were not found. Therefore, the possibility of homicide was low.

To determine the definite cause of death, an autopsy was performed a day after her death. No injury was found in the scalp. The scar at the right frontotemporal craniotomy was distinct on the skull without any fracture (Fig. 1). A fresh SDH was found in the right hemisphere (Fig. 2). The amount of SDH measured approximately 90 mL. After removing the SDH, SAH was distributed around the right sylvian fissure (Fig. 3) and at the base of the brain (Fig. 4A). Two sites of aneurysm clipping were found in the anterior communicating artery (Fig. 4A) and right internal carotid artery (Fig. 4B). Another aneurysm thought to be the caused by SAH

was found in the right proximal middle cerebral artery (Fig. 5A). This aneurysm measured approximately 1 cm (Fig. 5B). An uncal herniation was also observed with focal intracerebral hemorrhage (Fig. 6).

A mild atherosclerosis was found in the right coronary artery without abnormal finding of the myocardium. During the toxicology test, hypertensive medication, antihistamine, and sleeping pill were detected and within the therapeutic concentration ranges. Therefore, the possibility of poisoning was excluded. Because no injury was observed, and definite ruptured aneurysm was confirmed, we concluded that the cause of death was SAH with SDH due to ruptured *de novo* intracranial aneurysm.



Fig. 2. The diffuse subdural hemorrhage in the right hemisphere measured approximately 100 mL.

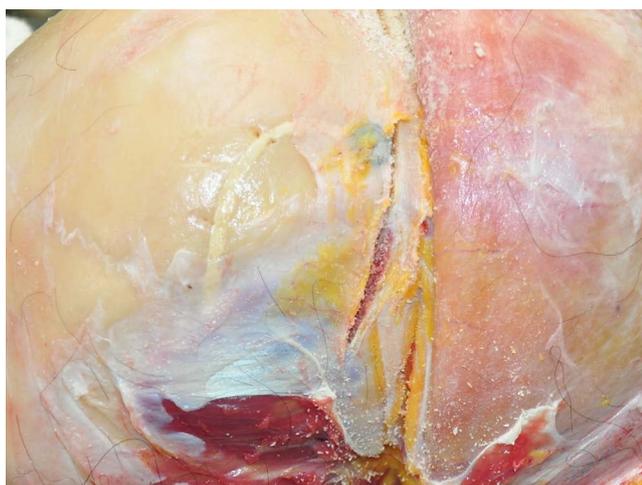


Fig. 1. The scar of craniotomy via pterional approach in the right frontotemporal bone.



Fig. 3. The subarachnoid hemorrhage centered in the right sylvian fissure after removing the subdural hematoma.

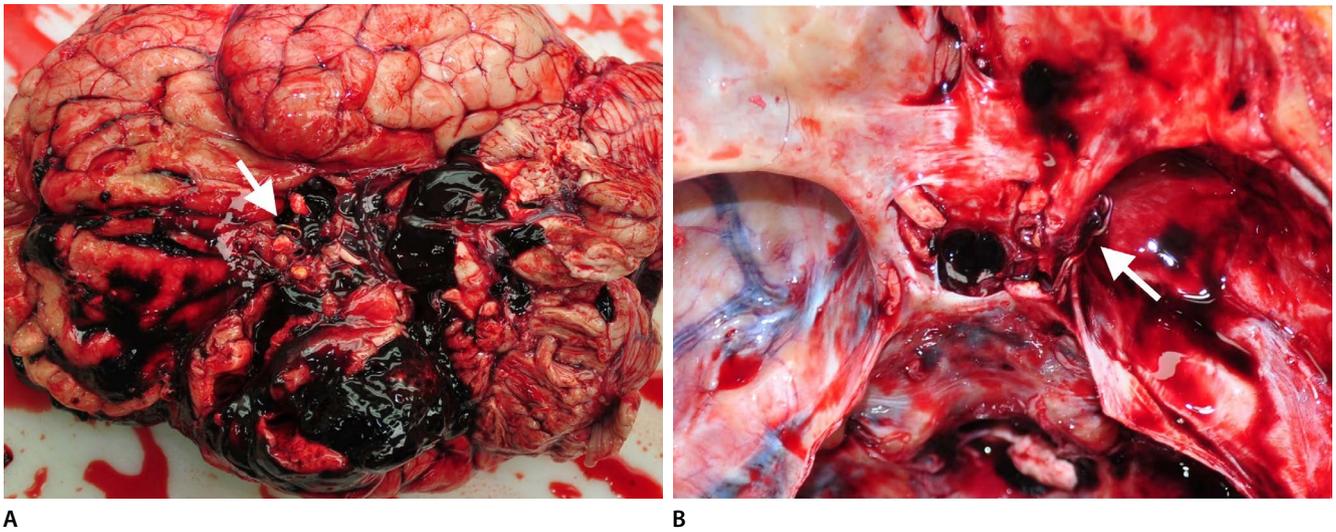


Fig. 4. Two aneurysmal clips. **(A)** The diffuse subarachnoid hemorrhage on the right side at the base of the brain and an aneurysmal clip (arrow) in the anterior communicating artery. **(B)** Another aneurysmal clip (arrow) in the right carotid artery.

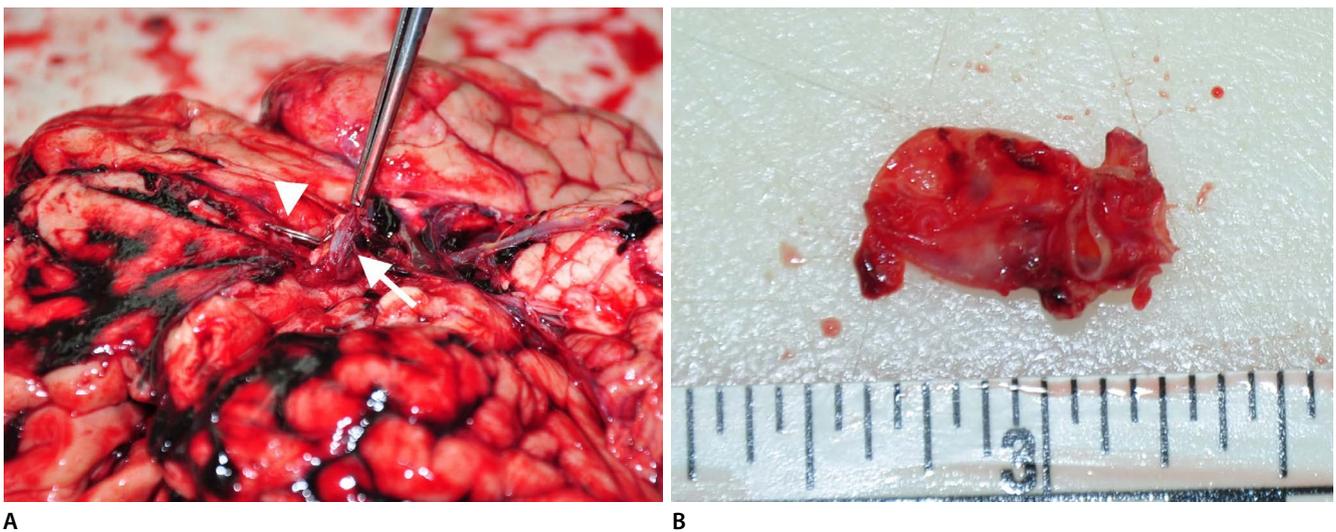


Fig. 5. *De novo* aneurysm. **(A)** The *de novo* aneurysm (arrow) at the right proximal middle cerebral artery and an aneurysmal clip (arrowhead) in the anterior communicating artery. **(B)** The *de novo* aneurysm measured approximately 1 cm (the ruler units: inches).

Discussion

Most ruptures of intracranial aneurysm are SAH and complicated with intracerebral and intraventricular hemorrhage. However, aneurysmal rupture sometimes causes SAH with SDH or only SDH [2–5]. Three mechanisms were proposed to explain aneurysmal SAH with SDH. First, when aneurysm is adherent to the arachnoid, aneurysmal rupture creates the passage of SAH to subdural space. Second, the pressure of blood lacerates weak points of the arachnoid. Finally, massive

SAH lacerates the arachnoid and leaks to the subdural space. SAH with SDH caused by these mechanisms was known to reduce the survival rate. For example, when Biesbroek et al. [6] analyzed 1,632 SAH patients in the single center, the presence of SDH was considered the risk factor of poor prognosis after SAH due to ruptured aneurysm.

However, in this case, we thought that the novel pathogenesis of SAH with SDH was the arachnoid defect after neurosurgery. The decedent had a neurosurgery: two aneurysmal clipping at the anterior

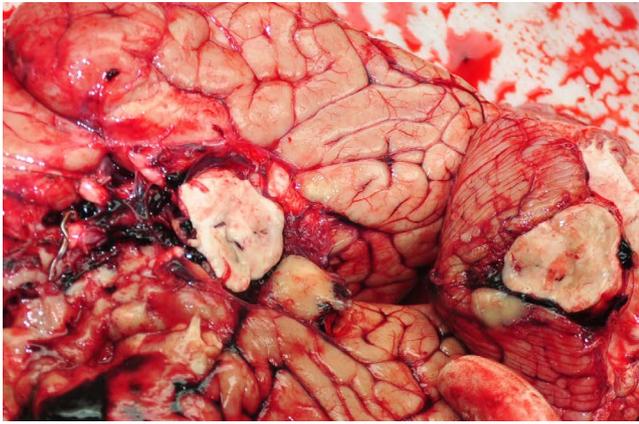


Fig. 6. An uncal herniation with intracerebral hemorrhage at the right side.

communicating artery and right internal carotid artery via pterional approach. Pterional approach include frontotemporal craniotomy, cutting the arachnoid, and clipping through the sylvian fissure. Because arachnoid is easily rolled, arachnoid repair (arachnoid plasty) is an unusual procedure after neurosurgery. Arachnoid plasty is sometimes performed to prevent chronic SDH after aneurysmal clipping [7]. However, we did not find the evidence of arachnoid plasty in the sylvian fissure. Therefore, we believe that the arachnoid defect around the sylvian fissure connected with subdural and subarachnoid spaces and the hemorrhage moved from the subarachnoid to subdural space through the defect after the rupture of *de novo* aneurysm in the right middle cerebral artery.

Because patients with aneurysms can live a long time after aneurysmal clipping, cases of recurrent intracranial aneurysm will increase. Tsutsumi et al. [8] performed a follow-up angiography on 225 patients with good general condition after aneurysmal clipping to estimate the recurrence rate of intracranial aneurysm. The regrowth of clipped aneurysms was detected in 2.9% of patients after aneurysmal clipping. The annual risk of *de novo* aneurysm formation was estimated to reach 0.89%. Therefore, when the patient was autopsied with the history of aneurysmal clipping, aneurysmal SAH with SDH can be found due to arachnoid defect.

As most SDH is caused by trauma, SAH related with SDH after the rupture of aneurysm is rare. Therefore, one of the most important medico-legal problem is to differentiate aneurysmal SDH from traumatic

SDH when SAH and SDH coexist. Several points should be considered for differential diagnosis. First, some degree of SAH can be involved in traumatic SDH [9]. Furthermore, because traumatic SDH occur with minimal trauma, the evidence of injury may not remain in the scalp. Second, when small aneurysm was ruptured, finding the ruptured aneurysm is difficult. Last, trauma can sometimes be considered as the cause of aneurysmal rupture. These variables should be primarily considered to find the definite cause of death in the complex situation. In addition, a person's movement on the last day before death should not be ignored. The history of neurosurgery, such as pterional approach, can explain the pathogenesis of SAH with SDH.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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