Spontaneous Subarachnoid Hemorrhage Caused by Ruptured Aneurysm of Basilar Trunk Perforator

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Case report

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Abstract

Background: The morbidity of BAPA is very low. Up to now, the pathogenesis and treatment of BAPA are not uniform. Conventional endovascular embolization and craniotomy seem not to be a good choice. We report a case of spontaneous subarachnoid hemorrhage caused by rupture of perforator aneurysm of basal trunk and successfully discharged after conservative treatment, suggesting that conservative treatment may be superior to surgical intervention.

Case presentation: A 65-year-old male patient with sudden headache and dizziness for five days was admitted to our hospital for emergency treatment. Spontaneous subarachnoid hemorrhage was diagnosed by DSA. We finally found that hemorrhage Caused by ruptured aneurysm of basilar Trunk perforator.After conservative treatment for two months,DSA showed that the aneurysm disappeared completely.

Conclusions: Aneurysm located at perforator artery of basilar trunk was rare and difficult to treat.Conservative treatment for certain cases with periodic angiography follow-up was recommended in order to prevent from potential iatrogenic effects.

Background

In 1986, van Gijn J et al first reported a group of SAH cases with negative results of DSA. The same feature is that the hemorrhage site on CT is mainly located in the brain cistern around the brain stem. It was speculated that the bleeding was from veins or capillaries, including occult arteriovenous malformations, telangiectasia or small segmental dissection of arteries and so on. Therefore they put forward the concept of "perimesencephalic nonaneurysmal subarachnoid hemorrhage (PNSH)" and this concept has been applied to today[27]. The CT images of the cases we reported are also consistent with the characteristics of PNSH, however, we found BAPA through DSA examination, it is suggested that this is one of the causes of the so-called PNSH[6]. The morbidity of BAPA is very low, Since the first case reported by Ghogawal Z et al in 1996, only 51 cases have been clearly reported so far (25 documents) [2]. Because the lesions are mostly small and there is a thrombus in the aneurysm so that the exact diagnosis is not easy. As in our case, emergency CTA did not show signs of aneurysm, It was concluded that DSA should be an important means to diagnose BAPA, and even multiple DSA reviews are sometimes needed in a short period to confirm the diagnosis[7].

Case Presentation

The patient was 65 years old. The history of "hypertension" and "diabetes" has been well controlled for many years. Because of "sudden headache, dizziness for five days" emergency admission, there is nausea and vomiting during the course of the disease. Physical examination at admission: conscious, meningeal stimulation positive, no signs of focal neurological deficits. Emergency head CT (computed tomography, CT) showed SAH around the brainstem. Emergency CTA (computed tomography
angiography, CTA) showed no obvious aneurysm or vascular malformation. DSA (Digital subtraction angiography, DSA) showed a small aneurysm of the dorsal perforating branch of the main trunk of the basilar artery, consistent with the site of bleeding. It was considered as a responsible lesion. The diameter of the aneurysm was less than 1.5 mm, and the perforating artery originated from the neck of the aneurysm. After communication with family members of patients, conservative treatment was carried out, and bleeding was absorbed after discharge two weeks later. On re-admission two months later, the patient was generally in good condition, no more headache attacks, no neurological deficits; reexamination of DSA found that the aneurysm completely disappeared and the perforator remained intact (Fig. 1).

Using "basilar artery", "perforator artery" and "aneurysm" as key words to search Pubmed network database, 45 articles were found. A summary of 25 references to perforating aneurysms of the basilar artery was selected (Table 1).
| First author(Year) | Number of cases | Site* | Treatment | Methods | follow-up(moon) | Prognosis |
|---------------------|----------------|-------|-----------|---------|----------------|-----------|
| Ghogawala Z (1996)  | 1              | distal| surgery   | Clipping| 6              | good      |
| Sanchez-Mejia RO    | 3              | distal| surgery   | isolate + resection| Unknown       | good      |
| (2007)[5]           |                | middle| surgery   | isolate + resection| Unknown       | good      |
|                     |                | middle| surgery   | isolate + resection| Unknown       | good      |
| Mathieson CS (2010)| 1              | distal| surgery   | Clipping+ resection| 5             | Hydrocephalus, Mild memory impairment |
| [7]                 |                |       |           |         |                |           |
| Chen L (2012)[9]    | 2              | middle| interventional therapy | Coil embolization| 24            | hemiplegia |
|                     |                | middle| interventional therapy | Coil embolization| 18            | hemiplegia |
| Nyberg EM (2013)[12]| 2              | middle| interventional therapy | stent-in-stent | 14            | good      |
|                     |                | middle| interventional therapy | stent-in-stent | 4             | good      |
| Ding D (2013)[13]   | 3              | middle| Conservative treatment | Onyx embolism | Unknown        | Cerebral steminfarction |
|                     |                | distal| Conservative treatment |          | 19            | good      |
|                     |                | distal| interventional therapy |          | 22            | hemiplegia |
| Chalouhi N (2014)[15]| 1             | middle| interventional therapy | flow diverter | 6             | good      |

Explanatory note*: The main artery of the basilar artery is divided into three parts that are called "the distal segment", "the middle segment", and "the proximal segment".
| First author (Year) | Number of cases | Site* | Treatment | Methods | follow-up (moon) | Prognosis |
|---------------------|-----------------|-------|-----------|---------|-----------------|-----------|
| Chavent A (2014)[16] | 3               | distal   | Conservative treatment | Conservative treatment | 6          | good      |
|                     |                 | distal   | Conservative treatment | Conservative treatment | 12         | good      |
|                     |                 | distal   | Conservative treatment | Conservative treatment | 6          | good      |
| Forbrig R (2016)[20] | 8               | distal   | Conservative treatment | Onyxembolism, Coil embolization | 6          | Left hemiplegia, Dysarthria |
|                     |                 | distal   | Conservative treatment | Coiling, Coiling | 6          | good      |
|                     |                 | distal   | Conservative treatment | Interventions | 60         | good      |
|                     |                 | distal   | Interventions | Interventions | 5          | good      |
|                     |                 | distal   | Interventions | Interventions | 23         | Hydrocephalus, Mild Cognition and gait disorders |
|                     |                 | distal   | Interventions | Interventions | 11         | Hydrocephalus, Left Hemiplegia |
|                     |                 | distal   | Interventions | Interventions | 15         | Hydrocephalus, Right Hemiplegia |
|                     |                 | distal   | Interventions | Interventions | 78         | Hydrocephalus, Right Hemiplegia |
| Satti SR (2016)[21]  | 1               | distal   | Interventions | Overlapping three stents | 7          | good      |
| Jiang Y (2016)[23]   | 1               | proximal | Electrocoagulation | Electrocoagulation | 6          | good      |

Explanatory note*: The main artery of the basilar artery is divided into three parts that are called "the distal segment", "the middle segment", and "the proximal segment".

**Discussion And Conclusion**
Although the cases reported so far are all caused by SAH, there are no reports of unruptured cases, so the natural history of BAPA is not clear [26]. Because of the small size of the aneurysm, it is difficult to complete superselective artery embolization. Because of the small size of the aneurysm, on the other hand, the aneurysm is located at the deep end, which makes it difficult to expose. Ischemic events caused by difficulties in perforating perforating branches are all problems to be considered when choosing a treatment plan. However, some cases were found to be self-healing during follow-up, so conservative observation under DSA follow-up was the preferred method in many reports [16]. Rehaemorrhage occurred in 6 of the 21 conservative cases reported in the literature (28.57%), of which 2 received microsurgery and 2 received endovascular intervention. (1 case was treated with coil embolization, and 1 case were implanted with flow diverter). 2 cases remained conservative. Of the 4 patients receiving intervention, only 1 recovered well, and the other 3 had neurological dysfunction of varying degrees due to perforator ischemic events. 2 patients who received conservative treatment recovered well. This result proves that the effect of active intervention may not be better than conservative observation [5, 6, 11, 20, 24].

Traditional microsurgical clipping is not the first choice in BAPA. Sanchez-Mejia et al. believed that such lesions usually had no neck of aneurysm, or even a type of vesicular aneurysm, which should be isolated along with the perforating branch of the aneurysmal artery, and the operation of proximal basilar artery control is also very difficult [5]. We had planned to design a three-dimensional printing model before microsurgical clipping of aneurysms [30]. However, a more backward approach to the inferior temporal bone is needed for direct observation of aneurysms during simulated surgery, which increases the risk of injury to the Labbe vein. And the depth of entry is above 7 cm, the surrounding nervous and vascular structures cause narrow operation space. A longer conventional straight aneurysm clip is needed to ensure that the clip does not occlude the field of view, and therefore does not guarantee the exact clipping of the aneurysm and preservation of the perforating artery. (Fig. 2).

The difficulty of endovascular interventional therapy is that superselective microaneurysms with microcatheters are prone to rupture and bleeding, and the perforating arteries are too small to be effectively protected. Of the 3 cases reported in the literature with coils and 2 cases with Onyx embolization, only one had a good recovery from distal perforator aneurysms of the main basilar artery and the rest had hemiplegia of varying degrees caused by perforator ischemic events [9, 13, 20]. Therefore, although it has been reported that the perforator artery as the parent artery can be compensated [29], whether it can be safely occluded remains to be discussed. Another option to consider is stent placement in the basilar artery. The hemodynamic study of aneurysm model showed that the blood flow velocity, eddy current and wall shear stress in the aneurysm cavity were significantly changed after the stent was implanted into the aneurysm neck. And the denser the mesh, the greater the impact [30]. Accordingly, FD seems to be an ideal choice, but this is not the case. The incidence of perforating infarction after posterior circulation aneurysms treated with FD was 14% [31]. Only one of the five FD BAPAs (4 with Pipeline and 1 with SILK) in the literature had no ischemic events. It is suggested that excessive hemodynamic changes may be a risk factor for perforator occlusion [15, 19, 24]. To this end, more patients try to choose the conventional stent-in-stent technique (Enterprise, Neuroform, Leo) for treatment. Half of the 10 reported patients had no definite ischemic events (the other 5 had no definite prognosis), suggesting that this
technique may be a better choice for BAPA intervention [12, 21, 26]. However, whether antiplatelet therapy will increase acute hemorrhagic complications remains to be seen in larger cases and longer-term follow-up.

Jiang Y et al. Reported a new method for the treatment of intracranial small aneurysms. When microcatheter is difficult to implant, only conductive micro-wires (such as Traxcess14) were implanted into the aneurysm cavity, and then electrocoagulated to occlude the aneurysm. They reported a case of proximal basilar artery perforator aneurysm. The aneurysm was not only obscured by this method, but also retained the parent artery[23]. This approach provides us with a new concept that seems promising to make BAPA's endovascular treatment process more convenient, safe, and cost-effective. However, there is no long-term follow-up study to determine whether the intraluminal thrombosis is stable enough.

**List Of Abbreviations**

PNSH: perimesencephalic nonaneurysmal subarachnoid hemorrhage;

BAPA: basilar artery perforator aneurysm;

**Declarations**

**Ethics approval and consent to participate**

This manuscript was obtained through retrospective collection of data. The article did not expose any personal information related to patients that can be effectively identified. The ethics committee thought that the ethical approval could be exempted, but we did not obtain official documents.

**Consent for publication**

A written informed consent has been taken from the patient during interictal period for presenting the clinical data and videos before sending this manuscript to the journal.

**Availability of data and material**

All are available in the manuscript.

**Competing interests**

The authors declare that they have no competing interests.

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Authors' contributions

Tao Wu: Conception and acquisition of clinical and electronic data and drafting of manuscript. Ailin Chen and Yao Wu: Conception and acquisition of clinical and electronic data and drafting of manuscript. Chungang Dai: Analysis of clinical and electronic data, drafting of manuscript. Qing Zhu: Analysis of clinical and electronic data, drafting of manuscript. All the authors read and approved the manuscript before sending the manuscript to the journal for publication.

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Figures
Figure 1

Image data of the case. a: SAH around brain stem was confirmed by head CT scan after onset. b: Emergent CTA did not demonstrate definite source of hemorrhage. c,d: 3DRA suggested a tiny aneurysm localized at posterior perforator artery of rostral basilar trunk. e,f: The lesion disappeared from DSA during 2 months follow-up with preservation of parent perforator artery.
Figure 2

Simulation procedure on printed three dimension model. a: Subtemporal keyhole approach of right side. The depth of aneurysm is 7 cm. b: The length of visible proximal basilar artery is only 5 mm between petrosal apex and aneurismal neck from operative view. c: The aneurysm can be clipped by longer clip after retraction of ipsilateral superior cerebellar artery. d: Relationship of clip and surrounding vascular structures after aneurismal clipping.

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