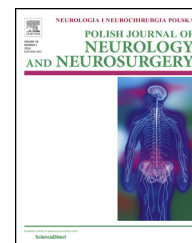


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Original research article

A challenging entity of unruptured giant saccular aneurysms of vertebrobasilar artery



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ABSTRACT

Purpose: Giant intracranial aneurysms commonly cause poor clinical outcome and few studies focus on them. This study is to retrospectively report the angiographic and clinical presentations in unruptured giant saccular vertebrobasilar aneurysms with and without endovascular treatment.

Methods: Out of 400 patients who had unruptured posterior circulation aneurysms in a single center, we found 10 unruptured giant (>25 mm) saccular vertebrobasilar aneurysms. Clinical and angiographic presentations as well as their clinical outcomes were assessed.

Results: Of the 10 giant aneurysms in 10 patients, three were left untreated. During 6 months follow-up, all 3 of these patients died from aneurysm rupture. The remaining 7 patients were treated by endovascular procedure, 5 received stent-assisted coiling, 1 was treated by parent artery occlusion (PAO), and 1 was treated by conventional coiling. Of these treated patients, only one survived during a 22 month period of follow-up.

Conclusions: Patients with giant saccular aneurysms of vertebrobasilar artery presenting mass effect may have extremely poor clinical outcomes and may not benefit from endovascular treatment.

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1. Introduction

The giant intracranial aneurysm is defined as having a maximum diameter exceeding 2.5 cm and often appears in saccular form [1–3]. This type of aneurysms accounts for less 5% of all intracranial aneurysms and is rare in the region of posterior circulation [2,4]. Aneurysms of posterior circulation, especially vertebrobasilar aneurysms, can lead to extremely

poor clinical presentations or fatal outcome such as ischemic effects, hydrocephalus, mass effect on the adjacent cranial nerves and brainstem, and common manifestations of acute subarachnoid hemorrhage [5–8]. Zhang et al. reported that 4 of 5 untreated patients with giant vertebrobasilar aneurysms had poor clinical outcomes [9]. Owing to the proximity of the brainstem and its complex neuroanatomy, the surgical procedure for giant vertebrobasilar aneurysm commonly confronts access limitations and technical challenges [7,10].

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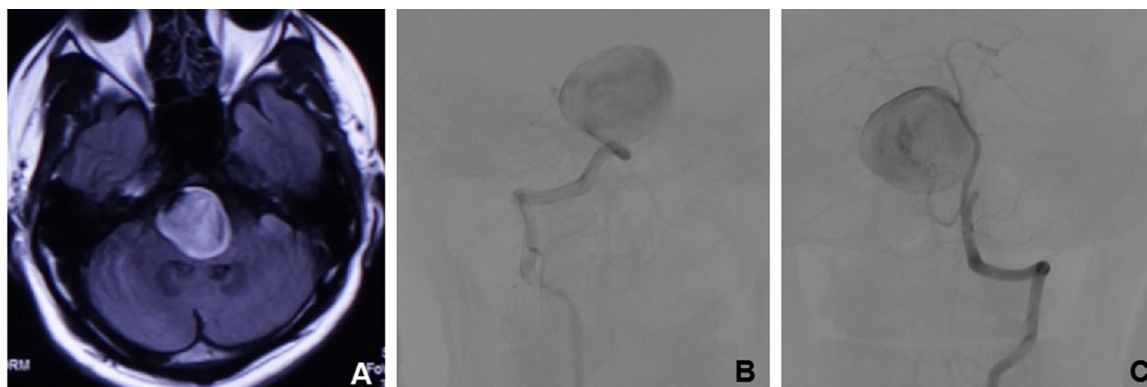


Fig. 1 – A verteobasilar junction giant saccular aneurysm. A 58-year-old man presented numbness. (A) Axial T1 MR imaging scan showed a giant mass in front of the pons. (B) Right vertebral artery angiogram showed a giant saccular aneurysm and the absence of basilar artery. (C) Left vertebral artery angiogram showed that the blood supply of left vertebral artery was not sufficient. This patient received conservative treatment because of a technical failure during the endovascular procedure. He died of aneurysmal rupture 6 months later.

In a study, the rate of excellent clinical outcome by surgical management for giant verteobasilar aneurysms was only 28.5% [7]. Additionally, results of a small study (8 patients) showed that endovascular embolization of giant verteobasilar aneurysms were also relatively difficult to cure [11]. However, there were few studies investigating highly complex giant aneurysms. The aim of this study is to report the challenges surrounding the current endovascular treatment methods of unruptured giant saccular verteobasilar aneurysms.

2. Methods and materials

A total of 10 consecutive patients with 10 unruptured giant saccular aneurysms of verteobasilar artery were enrolled between January 2008 and December 2014 at our hospital. All participants have signed the informed consent to participate in this study before they received endovascular treatment and the study was approved by the ethics committee of our hospital. There were 8 males and 2 females, and their mean

age is 41.4 years (range 29–77 years). These patients had no history of subarachnoid hemorrhage (SAH). Clinical characteristics, including demographic characteristics, radiological findings such as computed tomography angiography (CTA), magnetic resonance angiography (MRA), digital subtract angiography (DSA) and medical reports were retrospectively reviewed. All patients underwent cerebral DSA with three-dimensional (3D) reconstruction to confirm the dome and neck of aneurysm, the parent artery, and the origin and trajectory of nearby arterial branches for assisting the plan of treatment. Representative cases are provided in Figs. 1 and 2.

Nine patients presented with headache or severe neurologic deficits (Tables 1 and 2), one patient was detected incidentally. Four aneurysms involved the basilar artery, three aneurysms involved vertebral artery and three aneurysms were located at verteobasilar junction. These 10 aneurysms were saccular in shape and the size ranged from 25 to 40 mm ($31.0 \text{ mm} \pm 6.2 \text{ mm}$).

Giant saccular aneurysm commonly has a wide-neck and is difficult to be occluded. Intracranial stent system could

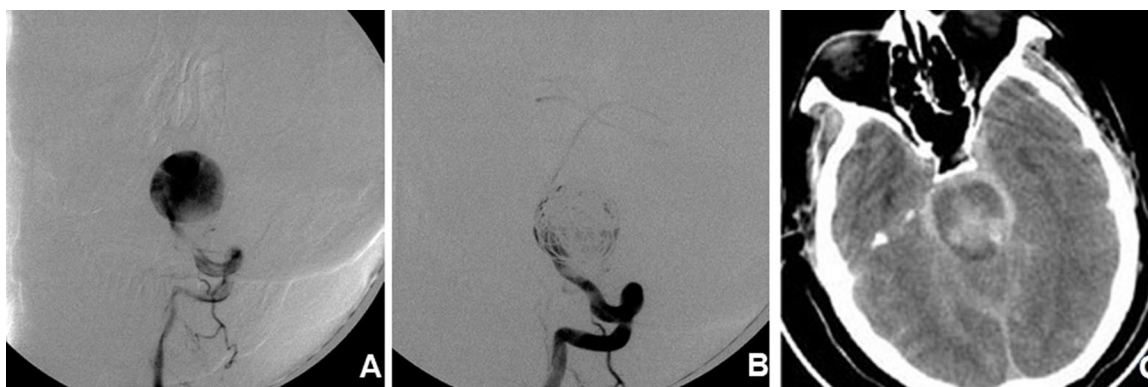


Fig. 2 – A left vertebral artery giant aneurysm. A 77-year-old male presented with severe headache, gait disturbance, dysarthria, nystagmus and hypoesthesia. (A) Left vertebral artery angiogram (frontal views) showed a giant saccular aneurysm located at left vertebral artery, which was treated by stent-coils embolization. (B) Post-operative angiogram in frontal views: giant aneurysm was embolized incompletely. (C) Emergency post-operative CT scan showed subarachnoid hemorrhage from the rupture of the giant aneurysm. The patient lost consciousness rapidly and died 3 days later.

Table 1 – Untreated patients demographics and outcomes.

No.	Age	Sex	Location	Size (mm)	Symptoms	Pre-mRS at admission	Follow up (month)	Clinical outcome
1	60	M	BA	26 × 23	Vertigo, gait disturbance	4	1	Died
2	65	F	RVA	27 × 22	Headache, vomit, diplopia	3	2	Died
3	58	M	VBJ	40 × 30	Numbness	2	6	Died

RVA, intracranial segment of the right vertebral artery; BA, basilar artery; VBJ, vertebrobasilar junction.

Table 2 – Endovascularly treated patients' demographics, treatment and outcomes.

No.	Age	Sex	Size (mm)	Location	Symptoms	Pre-mRS at admission	Treatment summary	Occlusion	Clinical outcome	Follow-up (months)
1	38	M	30 × 30	VBJ	Dysphagia, numbness, gait disturbance	4	Stent/coil (silk)	Complete	Died POD1 (hemorrhage)	–
2	44	M	36 × 26	BA	Vertigo, numbness	2	Stent/coil (Enterprise/solitaire)	Incomplete	Died POD1 (compression)	–
3	29	M	35 × 30	VBJ	Vertigo, vomit, numbness, dysphagia	3	Stent/balloon (Enterprise)	PVO	Died POD4 (artery occlusion)	–
4	44	M	26 × 15	LVA	Asymptomatic	0	Stent/coil (Enterprise)	Incomplete	Asymptomatic	22
5	31	F	40 × 35	TOBA	Limb asthenia, visual blurring, gait disturbance	4	Stent/coil (Enterprise)	Incomplete	Died POD5 (compression)	–
6	77	M	25 × 25	LVA	Headache, gait disturbance, dysarthria, nystagmus	4	Stent/coil (Neuroform)	Incomplete	Died POD3 (hemorrhage)	–
7	44	M	25 × 18	TOBA	Headache, visual blurring, vomit	3	Coil	Incomplete	Died (compression)	7

LVA, intracranial segment of the left vertebral artery; BA, basilar artery; VBJ, vertebrobasilar junction; TOBA, the top of basilar artery; PVO, parent vessel occlusion.

prevents coils protrusion into the parent artery and promotes a scaffold for endothelialization. When a stent was planned, antiplatelet therapy consisting of clopidogrel 75 mg and aspirin 100 mg was administered for at least five days before endovascular procedure. During the treatment process, 3000 IU of small molecule heparin was given at the beginning of each implantation and 1000 IU administered intravenously thereafter every hour. After the procedure, the patient was recommended with 75 mg clopidogrel for an additional 30 days, and 100 mg aspirin for an additional 6 months. One patient was treated by silk flow diverter and received 300 mg aspirin combined with 75 mg clopidogrel daily during the time of periprocedure.

The clinical follow-up was supplemented by telephone interviews for a period ranging from 1 to 22 months. Angiographic follow-up data was obtained for only 1 survival patient at 3 months. Besides, this patient received a clinical visit at 22 months after the endovascular procedure.

3. Results

Three patients encountered a technical failure during the endovascular procedure (one failed in navigating guiding catheter into vertebral artery, two failed in delivering the stent microcatheter across the neck of aneurysms), and they had to receive conservative treatment. The other seven patients were treated by endovascular embolization. Of the 7 treated patients, 6 of them received stent-assisted coils embolization

(one Neuroform, one Silk, one Enterprise & Solitaire, three Enterprise). One aneurysm was occluded with conventional coils. One aneurysm was treated by parent artery occlusion (PAO) with a detachable balloon and the deployment of Enterprise stent in the contralateral vertebral artery. Immediate post-procedural angiography revealed complete occlusion in only 1 patient (treated by coils and silk stent) and incomplete (partial or nearly complete) occlusion in 6 patients (four treated by coils combining with stents, one treated by PAO, one treated by conventional coils).

4. Outcome

During the follow-up period, extremely poor clinical outcomes were found. Three untreated patients (Table 1) died due to an aneurysmal hemorrhage which was confirmed by CT scanning at 1 month, 2 months and 6 months. Of the 7 treated patients (Table 2), endovascular embolization resulted in only 1 excellent outcome and 6 deaths by 7 months after procedure. Among these 6 dead cases, 3 were caused by severe brainstem compression after partial occlusion, 2 by fatal hemorrhage and 1 by the failure of collateral blood flow after bilateral vertebral artery occlusion. Of the two hemorrhage cases: one was caused by intraoperative bleeding; the other one received silk stent-assisted coils embolization and died of post-operative hemorrhage 4 days later. The survival patient was occluded near-completely by Enterprise stent-assisted coiling.

5. Discussion

Although there have been reports which demonstrated that giant (≥ 25 mm) intracranial aneurysms have a dismal natural progression, with neurological deterioration or fatal outcomes caused by rupture, ischemic events, or progressive mass effect [5], more details are needed for the decision of treatment strategy of unruptured giant saccular aneurysms of vertebrobasilar artery. The results of this small study of patients with unruptured giant saccular vertebrobasilar aneurysms showed 3 deaths of untreated cases and 6 deaths among 7 patients treated by endovascular management.

Choi and David demonstrated that a giant aneurysm may be the result of progressive, complex changes of a small aneurysm, due to hemodynamic stress and secondary healing response [2]. Swearingen and Heros considered that the risk of rupture increased with the size of aneurysms [12]. The potential of enlargement and eventually rupture of giant saccular vertebrobasilar aneurysms should not be neglected. Vertebrobasilar giant aneurysms could grow rapidly in a short time causing mass effect of brainstem and eventually rupture [13]. An international study indicated that unruptured giant aneurysms located at posterior circulation had a 50% rupture rate over a 5 year period [14]. Consistent with previous reports [15] of a 100% mortality rate within 2 years in untreated giant posterior circulation aneurysms, the 3 untreated patients in our study died of aneurysmal rupture within 6 months. Our study shows that unruptured giant saccular aneurysms of the vertebrobasilar artery have extremely disastrous natural progression if left untreated.

Treatment strategies are mostly influenced by the clinical presentation [16]. Kobayashi et al. concluded that interventional treatment (including endovascular and surgery) should be required under the condition of developing symptoms associated with mass effect or significant neurological deficits [17]. Except for the risk of rupture, the initial clinical symptoms caused by mass effects seem to be an important factor to estimate the clinical outcomes when patients receive endovascular treatment. In our study, all of the 9 patients with significant mass effects died. In the series of treated patients, although endovascular embolization changed the hemodynamics and induced the formation of intra-aneurysm thrombus, this technique increased aneurysm hardness substantially and did not release the initial compression of the brainstem in a short amount time. Darsaut et al. found that patients with poor baseline functional status, giant aneurysms, and aneurysms located at the vertebrobasilar artery predicted dismal outcomes at the final follow-up [5]. Similarly, Iihara et al. reported a study containing 12 giant vertebrobasilar aneurysms (saccular and fusiform) with significant mass effect treated by endovascular management or surgical management, and found that only 5 patients had improved outcomes or no complications [7]. In their report, 4 of 5 remaining patients whose giant aneurysms of the vertebrobasilar artery were detected incidentally had good or stable clinical prognosis. There was only 1 patient without initial clinical symptoms in our study who received stent-coils embolization obtaining an excellent prognosis.

PAO is a deconstructive therapy [18]. This technology is commonly planned for patients who have adequate collateral flow and can tolerate occlusion [9,16]. Vertebral artery occlusion has been well established [16], however, this technology is not the optimal treatment for every giant aneurysm. A report reviewed a case which received endovascular PAO and failed to block blood flow to the vertebral artery aneurysmal neck due to the vasa vasorum [19]. Long-term follow-up is still awaited to assess the risk of ischemic complications and even the appearance of new aneurysms which were caused by the resultant changes in hemodynamics [20]. For patients treated by right vertebral artery occlusion using a combination of a detachable balloon and an Enterprise stent implantation in the left vertebral artery, the status of the circulation or compensatory of posterior communicating arteries and effective antiplatelet therapy should be required before procedure.

Some novel flow diverters and endoluminal reconstruction devices (such as pipeline, silk, surpass stent) have been used for treating complex aneurysm extensively [6,21]. However, like other type of stents, flow diverters have the risk of sudden in-stent thrombosis and catastrophic bleeding complications [11,22]. Recently, experiences and results from flow diverters used in the treatment of aneurysms showed devastating immediate or delay ipsilateral intraparenchymal hemorrhage [23]. Alderazi also indicated that antiplatelet therapy could complicate the use of flow diverters and facilitate rebleeding of ruptured aneurysms after stent-assisted treatment [24]. Fox reported a case of early aneurysmal rupture following treatment using flow diversion [25]. Another study demonstrated the fatal hemorrhagic complication of the silk stent when used during antiplatelet therapy [26]. Kulcsár et al. found 3 basilar artery aneurysms ruptures following the implantation of a silk stent [27]. Meckel et al. [28] reported a study containing of 10 complex aneurysms at the vertebrobasilar junction treated by flow-diverting stents and 4 cases died. A literature [29] referring to the long-term follow-up of the pipeline reminded that giant vertebrobasilar aneurysms may not be benefited from the flow-diverter embolization (3 death in 4). There is still insufficient data to support the efficiency of flow-diverters for unruptured giant saccular aneurysms of vertebrobasilar artery.

6. Limitations of the study

Our study has limitations. First, there were not sufficient cases with unruptured giant saccular vertebrobasilar aneurysms in our institution from 2009 to 2014. Second, few patients accepted the angiography as the method of follow-up.

7. Conclusion

The rupture of giant vertebrobasilar aneurysms commonly causes immediately fatal intracranial hemorrhage, even after receiving endovascular treatment. Unruptured giant saccular aneurysms of the vertebrobasilar artery with mass effect may not benefit from this technology completely.

Conflict of interest

None declared.

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Ethics

The study was approved by the ethics committee of Beijing Tiantan Hospital.

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