Safety and effectiveness of endovascular treatment for ruptured vertebral artery dissecting aneurysms in the acute stage

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Abstract

Background: Ruptured vertebral artery dissecting aneurysms (VADA) should be treated promptly because of the high risk of rebleeding. However, it is difficult to treat dissecting aneurysm during the acute stage by microsurgery because of high intracranial pressure or brain edema. Therefore, endovascular treatment of the ruptured VADA may be a better technique. We retrospectively studied the efficacy and outcome of endovascular treatment of ruptured VADA in the acute stage.

Methods: Nineteen patients with ruptured VADA received endovascular treatment in the acute stage. Among them, 17 were treated by internal trapping of the dissected segment. We performed stent-assisted coiling for a case of VADA in the contralateral hypoplastic VA and a case of bilateral dissection (ruptured VADA of the right VA and dissection of the left VA).

Results: Seven patients (37%) had good recovery, 3 patients (26%) had moderate disability, 3 patients (16%) had severe disability, one patient (5%) entered a persistent vegetative state, and 3 patients (16%) died. There was no recurrent hemorrhage after endovascular treatment, but complications related to the endovascular procedures occurred in 3 patients.

Conclusion: Endovascular treatment of ruptured VADA in the acute stage appears to be safe and effective.

Keywords: endovascular treatment, ruptured dissecting vertebral aneurysms, acute stage

1. INTRODUCTION

Intracranial vertebral artery (VA) dissection occurs more commonly in middle-aged men with untreated hypertension. There are two main outcomes of intracranial VA dissection: subarachnoid hemorrhage (SAH) due to ruptured lesion and ischemic obstructive lesion. Ruptured intracranial VA dissection resulting in massive SAH is one of the main causes of fatality.

Rupture of the intracranial VA is caused by excessive adventitial dilatation of a vertebral artery dissecting aneurysm (VADA) (Ro & Kageyama, 2013). When VADA leads to SAH, the risk of recurrent hemorrhage is extremely high. Yamada et al. reported that among 24 conservatively treated patients with ruptured VADA, 14 (58%) experienced a total of 35 re-bleeding episodes. Among these 14 patients, 13 died and 11 of these deaths were directly attributable to rebleeding (Yamada et al., 2004). Therefore, it is recommended that ruptured VADA should be treated within 24 hours because of the high risk of re-bleeding and the high morbidity and mortality. Nevertheless, it is difficult to treat VADA during the acute stage by craniotomy because of high intracranial pressure or brain edema.

In recent years, endovascular treatment of VADA has evolved as an alternative to surgical treatment and may consist of proximal vertebral occlusion, internal coil trapping, stent-assisted coiling, or stent placement as the only therapy (Ahn et al., 2006; Leibowitz et al., 2003; Mehta et al., 2003; Yamaura et al., 1999). Here, we present a retrospective study of the efficacy and outcome of endovascular treatment of ruptured

VADA in the acute stage.

2. MATERIAL and METHODS

2.1. Patient Characteristics

Between January 2004 and July 2016, we treated 19 patients with ruptured VADA in the acute stage using the endovascular technique at our institute and affiliated hospital. They were 14 males and 5 females ranging in age from 38 to 74 years (mean 49.4 years). SAH was diagnosed on the basis of findings from computed tomography of the brain. Identification of dissecting aneurysms was based primarily on angiographic criteria. Two patients had dissecting aneurysm involving the origin of the posterior inferior cerebellar artery, PICA (PICA-involved type), 11 patients had VADA occurring at a distal site of the VA from the origin of the PICA (post-PICA type), 3 patients had VADA occurring at a proximal site of the VA from the origin of the PICA (pre-PICA type), and 3 patients had no PICA signal in the ipsilateral vertebral artery with dissecting aneurysm (No-PICA type).

2.2. Endovascular procedure

All the patients were placed under general anesthesia or intravenous anesthesia in the angiography room. A 6.0F or a 5.0F ultra-long sheath as a guiding catheter was placed in the affected VA at the cervical portion via the right femoral artery. The guiding catheter was perfused continuously with normal saline flush solution containing heparin (5,000 U/L). Another 5.0F catheter was used to obtain an angiogram of the contralateral VA during the procedure. When internal trapping was performed, a guidewire was advanced to a position distal to the dissecting aneurysm, followed by a microcatheter to maintain the true lumen of the vessel. The microcatheter

was pulled back to the distal portion of the dissecting aneurysm. The platinum coil was placed just distal to the VADA, and detachable coils were placed at the site of aneurysmal dilatation. When stent assisted coiling (SAC) was performed for the ruptured VADA, the microcatheter was first placed in the aneurysmal dilatation, then stent placement from the distal normal VA to the proximal normal VA crossing the VADA was performed under dual antiplatelet and anticoagulant therapy. After stent placement, coil embolization was carefully performed with a soft platinum coil in the aneurysm.

2.3. Postoperative management

Post-procedurally, all patients underwent close neurological monitoring in our intensive care unit. Antiplatelet therapy with clopidogrel, cilostazol or aspirin was maintained for at least 3 months after treatment. When stent assisted coiling (SAC) was performed, dual antiplatelet therapy was maintained for 1 year after treatment. Serial follow-up angiographic examinations were performed to ensure complete angiographic healing with occlusion of the dissected segment with conventional DSA or MRA. The patient outcome was assessed according to the Glasgow Outcome Scale at 3 months after onset.

3. RESULTS

Approximately three-fifths of the cases were middle-aged men. The incidence of poor Hunt & Kosnic grade (Grade IV and V) on admission was 73.7%. All the patients received endovascular treatment. Seventeen patients with VADA were treated by internal trapping of the dissected segment and parent artery occlusion. We performed stent-assisted coiling (SAC) for two cases of VADA, one with contralateral

hypoplastic VA and one with bilateral VADA. Seven patients (37%) had good recovery, 3 patients (26%) had moderate disability, 3 patients (16%) had severe disability and 3 patients (16%) died from initial severe SAH. One patient (5%) who suffered from hypotension due to gastrointestinal bleeding after 7 days of endovascular treatment entered a persistent vegetative state. There was no recurrent hemorrhage, but complications related to endovascular procedures, such as rupture, brain stem infarction and extracranial VA dissection with the guiding catheter, occurred in 3 patients. One patient (patient 9) who was treated by SAC presented ischemic complications post treatment, associated with a change from clopidogrel to aspirin owing to liver dysfunction (Table 1).

4. ILLUSTRATIVE CASES

4.1. Case 1

An unconscious 56-year-old male (patient 19) was admitted to our hospital. Computed tomography (CT) revealed severe SAH, and his status was estimated as Hunt and Kosnik grade IV. An angiogram demonstrated dissecting aneurysm of the left VA; the contralateral VA supplied sufficient blood to the basilar artery and posterior cerebral artery, so we attempted internal trapping for the left VADA via the left VA. However, iatrogenic VA dissection with the guiding catheter occurred perioperatively. Therefore, internal trapping was performed with platinum coils via the contralateral VA. Postoperative angiography demonstrated that the aneurysm and the parent vessel were completely obliterated and the left posterior inferior cerebellar artery was

preserved (Fig.1). The patient did not present recurrent hemorrhage or neurological deficit.

4.2. Case 2

A 54-year-old male (patient 9) was admitted to our hospital complaining of severe headache. Computed tomography (CT) revealed mild SAH in the posterior fossa, and his status was estimated as Hunt & Kosnik grade II. An angiogram demonstrated bilateral dissections, ruptured VADA of the right VA and VA dissection of the left VA. It has been reported that patients with bilateral dissections, who are treated with parent artery occlusion on one side, may suffer rupture of the contralateral lesion[7]. Therefore, stent assisted coiling (SAC) was performed for the ruptured VADA of the right VA without occlusion of the right VA or ischemic complication during endovascular treatment (Fig.2). The patient did not present recurrent hemorrhage or neurological deficits immediately after the SAC. However, ischemic complication was observed after 14 days associated with a change from clopidogrel to aspirin owing to liver dysfunction. MRI-DWI revealed ischemic lesion in the lateral medulla oblongata following the endovascular treatment.

5. DISCUSSION

The outcome of ruptured VADA is generally poor because of the poor grade on admission and high incidence of recurrent hemorrhage in the extremely early stage. Therefore, VADA presenting with subarachnoid hemorrhage (SAH) should be treated promptly. The preferred therapy for dissecting artery is trapping. However, it is difficult to perform trapping by craniotomy due to brain edema and high intracranial pressure. Trapping is especially difficult in the

acute stage of SAH if dissecting aneurysms are located near the median part of the brainstem (Uhl, Schmid-Elsaesser, & Steiger, 2003).

There have been several studies and case reports describing endovascular therapy for treatment of vertebral dissecting aneurysms (Kai et al., 2003; Peluso et al., 2008). Internal trapping and proximal occlusion of the parent artery with detachable coils, as shown in Figure 2, can provide a favorable outcome in the majority of patients (Albuquerque et al., 2005; Kai et al., 2003).

VADA are classified according to the originating portion of the VA and dissecting segment as post-PICA, pre-PICA, PICA-involved, and no-PICA types, as described in Materials and Methods. Internal trapping is suitable for VADA of the post-PICA pre-PICA, and no-PICA types, but this approach is hardly indicated for patients with VADA involving the origin of the PICA (PICA-involved type), because of the risk of ischemic complications in the PICA territory. In a recent report, medullary infarction after endovascular treatment was associated with poor outcome after internal trapping for ruptured VADA (Endo et al., 2013). Also, for patients with contralateral hypoplastic or aplastic VA and patients with bilateral VADA, internal trapping is not suitable because of the risk of ischemic complications and rupture of the contralateral dissected lesion (Otawara et al., 2002). Several reports have described the use of stent endovascular treatment, such as stent-assisted coiling (SAC), for these patients (Ahn et al., 2006; Chung et al., 2010; Peluso et al., 2008; Suh et al., 2009).

SAC may be used for VADA where internal trapping of the dissected segment of the parent artery in the acute stage is

difficult or inappropriate, but ischemic complication is likely to develop. The optimum treatment for dissecting aneurysm of these patients in the acute stage of SAH remains to be established.

6. CONCLUSIONS

VADA presenting with subarachnoid hemorrhage (SAH) should be treated promptly because of the high risk of recurrent hemorrhage. In our patients, there was no re-bleeding after endovascular treatment and few procedure-related complications were encountered. Even when it is difficult to perform trapping by craniotomy for VADA due to brain edema and high intracranial pressure in the acute stage of SAH, endovascular treatment appears to be safe and effective.

CONFLICTS of INTEREST

None.

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Tables and Figures

Fig. 1

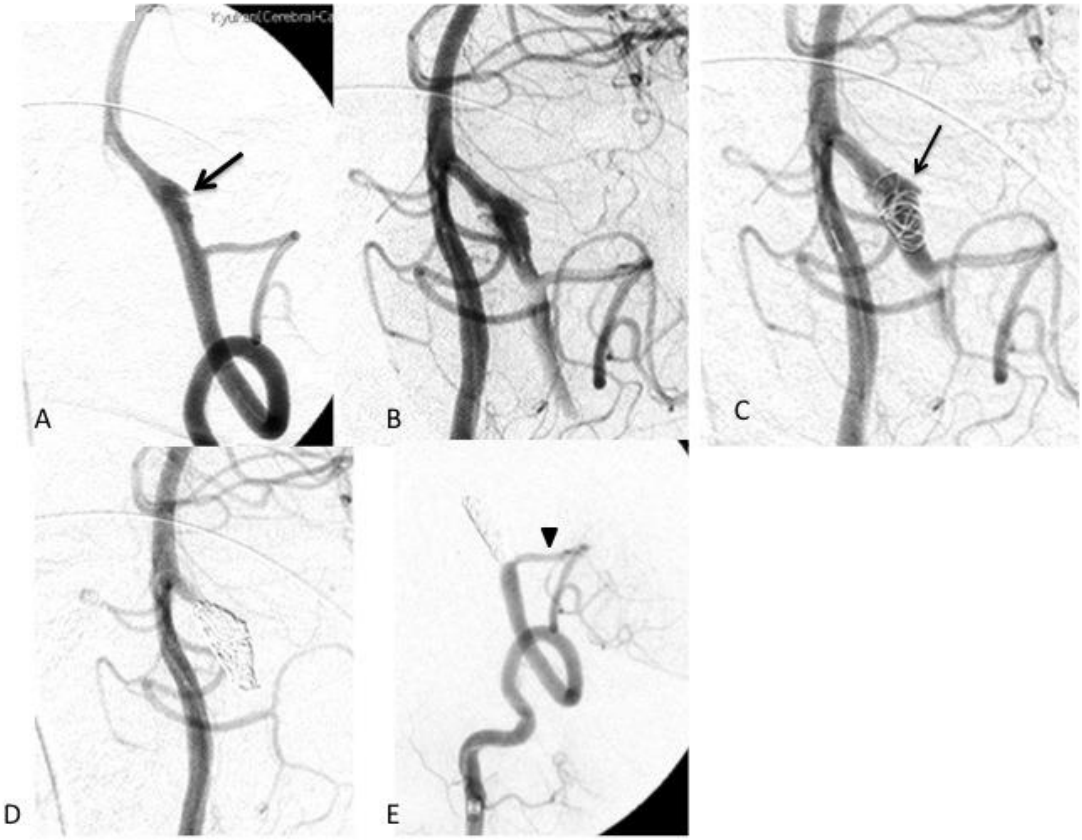

Figure 1. Working angle of right VA angiogram showing bilateral VA dissections (A). Nonsubtracted fluoroscopic image before balloon-expandable stent was deployed and microcatheter was placed in the VADA (B). After deployment of balloon-expandable stent across the aneurysm neck and placement of platinum coils in the aneurysm (C). Right VA angiogram after coil embolization assisted with balloon-expandable stent (D). The VADA was almost totally occluded with coils.

Fig. 2

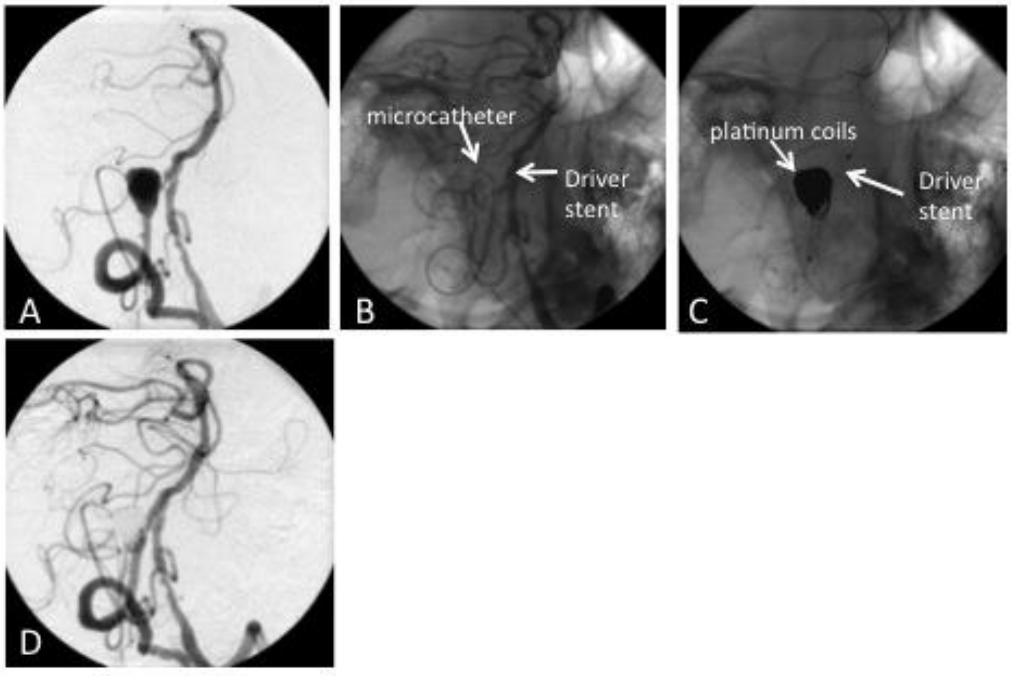

Figure 2. Working angle of left VA angiogram before internal trapping. VADA is seen at a distal site of the VA from the origin of the PICA (arrow) (A). However, left extracranial VA dissection occurred when a microcatheter was positioned in the VADA via the contralateral VA (B). Image after the first coil (arrow) was placed in the VADA (C). Right VA angiogram after internal trapping by coil embolization (D). The VADA was totally occluded with coils and the PICA (arrowhead) was well visualized (E).

Table 1. Summary of endovascular treatment for ruptured VADA in the acute stage

No.	Age/sex	H&K	Angiographic findings	Procedure	GOS	Complication
1	38/M	IV	PICA-involved	IT	D	None
2	52/M	II	Post-PICA	IT	GR	None
3	55/M	IV	Post-PICA	IT	MD	None
4	70/F	IV	Post-PICA(contralateral hypoplastic VA)	SAC	MD	None
5	43/F	II	Post-PICA	IT	GR	None
6	65/M	IV	No PICA	IT	GR	None
7	40/M	IV	No PICA	IT	SD	None
8	45/F	V	Post-PICA	IT	MD	None
9	59/M	II	Post-PICA, bilateral VADA	SAC	MD	Ischemia
10	39/M	IV	Post-PICA	IT	GR	None
11	41/M	V	Pre-PICA	IT	SD	None
12	52/M	V	Pre-PICA	IT	D	Rupture
13	61/M	V	Post-PICA	IT	SD	None
14	47/F	IV	Pre-PICA	IT	MD	None
15	47/M	III	No PICA	IT	GR	Ischemia
16	46/M	IV	Post-PICA	IT	D	None
17	74/M	IV	PICA-involved	IT	PVS	GIB
18	63/F	III	Post-PICA	IT	GR	None
19	56/M	IV	Post-PICA	IT	GR	Extracranial VA dissection

VA: vertebral artery, H&K: Hunt & Kosnic grade, PICA: posterior inferior cerebellar artery, IT: internal trapping, GOS: Glasgow Outcome Scale, GR: good recovery, MD: moderate disability, SD: severe disability, PVS: persistent vegetative state, D: death GIB: gastrointestinal bleeding

