Transvenous Embolization for Dural Arteriovenous Shunt of the Cavernous Sinus

Comparison of Multi-Staged Transvenous Embolization and Transvenous Embolization with Sinus Packing

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Summary

We describe the treatment and follow-up clinical symptoms and angiographic results in patients with dural arteriovenous fistula of the cavernous sinus treated by transvenous embolization (TVE). We have treated eight cases of dural arteriovenous fistula of the cavernous sinus by multi-staged TVE in two cases and TVE with sinus packing in six and three of six cases were treated with a combination of transarterial embolization. Multi-staged TVE was performed by occlusion from dangerous drainage veins to the cavernous sinus on several occasions.

Angiographical results showed disappearance or reduction of the arteriovenous shunt in all cases. Six patients presented with ophthalmic symptoms and two had tinnitus. Six cases had complete disappearance of clinical symptoms after treatment. There was a deterioration of ocular movement in one patient treated by TVE with sinus packing. Multi-staged TVE was performed to reduce the coil volume for the packing of the cavernous sinus in two cases without cranial nerve palsy. Embolization, especially multi-staged TVE, was considered a good treatment to occlude arteriovenous shunts at the cavernous sinus without cranial nerve complications.

Introduction

Dural arteriovenous fistula of the cavernous sinus often presents with ophthalmic symptoms and there are multiple shunts at the dural wall of the cavernous sinus. Endovascular embolization was performed by transarterial and transvenous approach. Transvenous embolization (TVE) is currently preferred, but TVE was occasionally impossible to access. We studied the clinical symptoms, angiographic findings, efficacy and problem of TVE for dural arteriovenous fistulas of the cavernous sinus and report two cases who had dural arteriovenous fistula treated by multi-staged endovascular treatment.

Material and Methods

Eight patients with dural arteriovenous fistula of the cavernous sinus were treated. Their ages ranged from 55 years to 76 years (mean age: 66.8 years) and two men and six women were included. Polyvinyl alcohol copolymer particles was used as embolic materials for transarterial embolization (TAE) and TVE was performed using platinum coils. TVE with sinus packing was performed by packing of drainage route and the cavernous sinus until the arteriovenous shunt was occluded. Multi-staged TVE was performed in cases who had opened a

Figure 1 A) Left internal carotid angiogram showing the arteriovenous shunt in the cavernous sinus. B) Left external carotid angiogram showed multiple feeders to the cavernous sinus. C) Skull X ray film showing multiple platinum coils within the cavernous sinus. D) Postoperative common carotid angiogram showing complete disappearance of the arteriovenous shunt.

drainage route of the inferior petrosal sinus through the IPS approach. Firstly the cortical draining vein, ophthalmic vein and adjacent cavernous sinus were occluded with preservation of the posterior part of cavernous sinus and inferior petrosal sinus drainage route. In cases with a drainage route of cortical and ophthalmic veins on both sides, one side of the cortical and ophthalmic venous routes and adjacent cavernous sinus were occluded in one session and another session was performed to occlude venous drainage on the contralateral side. Additional TVE was performed to oc-

clude the drainage route of intercavernous sinus, pterygoid plexus and adjacent cavernous sinus and finally we occluded the posterior part of the cavernous sinus and inferior petrosal sinus using a minimal amount of standard and fibred coils which were introduced into the fistula and cavernous sinus in multi sessions.

Results

Initial symptoms were conjunctival chemosis and diplopia in three patients, diplopia in two, chemosis in one, and tinnitus in two (Table 1).

Figure 2 A) AP view of the left common carotid angiogram demonstrating the arteriovenous shunt at the cavernous sinus. B) Lateral view of left common carotid angiogram showing drainage route to the cortical vein, superior ophthalmic vein and inferior petrosal sinus. C) Skull X-ray film showing a small amount of coils at the cavernous sinus. D) Postoperative left common carotid angiogram showed complete occlusion of the arteriovenous shunt.

Angiographic findings were classified into Barrow Type D in all patients. For the treatment, TVE was performed in three patients, a combination of TVE and TAE in three, and multi-staged TVE in two. TAE was performed to reduce the arterial pressure using PVA particles. Angiography showed patency of the inferior petrosal sinus in five out of eight patients (Table 2).

The transvenous approach from the inferior petrosal sinus was tried in eight cases. One case was inaccessible because of the occlusion and/or stenosis of the inferior petrosal sinus

(Table 2) and a transvenous approach through the superior ophthalmic vein was carried out in this case. Multi-staged TVE was carried out in two patients who had an inferior petrosal sinus drainage route.

After the treatment symptoms disappeared or improved in six patients, were unchanged in one, and deteriorated in one (Table 1). The deteriorated symptoms were disturbance of extraocular movement caused by sinus packing with coils. Angiographical result showed disappearance or reduction of the arteriovenous shunt in all cases (Table 3).

Table 1 Summary of the clinical symptoms.

	Initial symptom	No.	Postoperative change		
			Disappear	Unchanged	Deteriorated
TVE	Chemosis, Diplopia	1	1	1	1
	Diplopia	1			
	Tinnitus	1			
TVE + TAE	Chemosis, Diplopia	1	1		
	Chemosis	1	1		
	Diplopia	1	1		
Multi-staged TVE	Chemosis, Diplopia	1	1		
	Tinnitus	1	1		
Total		8	6	1	1
TAE: transarterial embolization, TVE: transvenous embolization					

Table 2 Summary of transvenous approach.

Treatment methods	No.	Inferior petrosal sinus		IPS approach	
		opacified	unopacified	Success	Failed
TVE	3	2	1	3	0
TVE + TAE	3	1	2	2	1*
Multi-staged TVE	2	2	0	2	0
Total	8	5	3	7	1
*TVE was performed through superior ophthalmic vein.					

Table 3 Result of angiographic change and treatment methods.

Treatment methods	No.	Result of angiographic change	
		Disappeared	Reduced
TVE	3	2	1
TVE + TAE	3	3	0
Multi-staged TVE	2	2	0
Total	8	7	1
TAE: transarterial embolization, TVE: transvenous embolization			

Illustrative cases

Case 1 (TVE with sinus packing)

A 55-year-old woman experienced diplopia. Left internal and external carotid angiograms showed the fistula on the left side (figure 1 A,B). The fistula was classified as Barrow Type D. A transfemoral-transjugular approach via the left inferior petrosal sinus was chosen. The cavernous sinus was packed with multiple standard and fibered coils (figure 1C). The fistula was occluded (figure 1D). She showed transient deterioration of left abducens nerve palsy after the treatment.

Case 2 (Multi-staged TVE)

A 62-year-old woman presented with tinnitus. Angiography revealed dural arteriovenous fistula at the cavernous sinus (figure 2 A,B). There was an arteriovenous shunt to the cortical vein, superior ophthalmic vein and inferior petrosal sinus. Bilateral internal carotid artery and external carotid artery fed the fistula. Multi-staged TVE was chosen. The drainage route of cortical and superior ophthalmic veins was occluded in four sessions. Then a minimal amount of standard and fibered coil was introduced into the fistula and cavernous sinus (figure 2C). The arteriovenous shunt was occluded (figure 2D). The tinnitus disappeared after treatment.

Discussion

There are multiple arteriovenous shunts at the wall of the cavernous sinus in dural arteriovenous fistula of cavernous sinus and the patients often presented with chemosis, exophthalmos, cranial nerve palsy, and intracranial hemorrhage^{1,2}. In our eight cases, six had ocular symptoms.

For the treatment of dural arteriovenous fistula of the cavernous sinus, TAE, TVE, and radiotherapy were performed¹⁻⁵. Recently TVE was often selected because of its positive effect on the clinical and angiographic outcome. Uflacker reported the TVE for dural arteriovenous fistula of the cavernous sinus through the superior ophthalmic vein⁶. Another venous approach using the inferior and superior petrosal sinuses, pterygoid venous plexus and facial vein were reported⁵. In our series, the inferior petrosal sinus and ophthalmic vein were used for the venous approach. TVE treatment had a limitation to obliterate the arteriovenous shunt when

the venous route was occluded. From our study, 87.5% of the cases were successfully treated by TVE through the inferior petrosal sinus.

When the cavernous sinus was filled with coils to obliterate the arteriovenous shunt, several complications were reported^{2,7,8}. One of the complications is cranial nerve palsy and there are several causes. Traumatic nerve injury may be caused by the microcatheter and/or microguidewire during TVE. Embolic materials and induced thrombosis may cause a mass effect to the cranial nerves. Vinuela reported disturbance of extraocular movement in one of 20 treated cases². Takahashi reported transient postoperative extraocular movement disturbance in five of 22 TVE treated cases⁷. We experienced one case, who had deterioration of abducens nerve palsy after overpacking of the cavernous sinus. After the experience of this case, we selected a multi-staged TVE to reduce the amount of coil volume. There is a possibility of potential risk of angiographic complications when we perform multiple sessions. We need a meticulous procedure during the embolization.

We planned multi-staged TVE to reduce the amount of coils for sinus packing in two patients who had been diagnosed with drainage routes through the patent inferior petrosal sinus. There is a possibility that the shunt assumes an aggressive pattern after the occlusion of venous drainage route in this treatment. During the multi-staged TVE, the dangerous drainage routes, such as cortical and ophthalmic veins, should be occluded first. We selected the patients who had an open inferior petrosal sinus for this treatment. We preserved the drainage route through the inferior petrosal sinus until final embolization. Preservation of inferior petrosal sinus drainage might reduce the possibility to form new drainage routes. The inferior petrosal sinus was occluded after recognition of the disappearance of the arteriovenous shunt of the cavernous sinus in the final session. Occlusion of outflow and partial sinus packing may produce consecutive thrombosis of the cavernous sinus. Viñuela et Al reported spontaneous occlusion of the sinus in three out of 20 cases². He suspected that partial thrombosis might promote complete occlusion of the cavernous sinus. We insist that a follow-up angiogram is indicated to recognize the complete occlusion of the shunt. We thought a multi-staged TVE would diminish the insertion of the coils within the cavernous sinus avoiding

over-packing of the sinus not to promote cranial nerve palsy.

Conclusions

Decrease or disappearance of arteriovenous shunt was obtained by endovascular treatment.

The achievement of transvenous embolization depends on the patency of the venous routes. The final purpose was the complete occlusion of the arteriovenous shunt at the cavernous sinus and multi-staged TVE reduced the coil volume in the cavernous sinus in order to avoid cranial nerve palsy.

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