



## Original Research Article

## Intra aneurysmal double microcatheter technique for complex aneurysm

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## ABSTRACT

**Purpose:** Wide neck aneurysms can be treated with several methods. In this study, we share our experience of intra aneurysmal double microcatheter technique to treat complex intracranial wide-neck aneurysms with unusual shapes.

**Materials and Methods:** Ten patients with wide-neck intracranial aneurysms were treated using the endovascular method of the double microcatheter between December 2013 to September 2014. All patients had presented with acute subarachnoid hemorrhage on plain CT brain. Detailed demographic information and aneurysm morphology by DSA were noted. Aneurysms were coiled using a double microcatheter technique. Follow up done up to 1 year.

**Result:** All aneurysms were completely embolised using a double microcatheter technique. DSA has done immediately post embolization showed class I filling in 9 patients and class II filling in 1 patient using the Raymond-Roy Classification system. The mean neck diameter was 2.91 mm (range 2 to 4 mm) and the mean dome of neck ratio was 1.34 (range 0.89 to 2.14). All these patients were relatively in good grade before the procedure, an improvement was noted during the one year of follow-up.

**Conclusion:** In our series, this modified intra aneurysmal double catheter technique is safe, effective, not costly, and not technically demanding.

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## 1. Introduction

Endovascular treatment of complex aneurysm in acute aneurysmal subarachnoid hemorrhage poses several challenges, including reduced effectiveness as the size of neck orifice increases. Achieving complete occlusion without compromising the parent vessel is affected by various factors such as neck size, dome neck ratio, the shape of the aneurysm, relationship to neighboring vessels, and tortuosity to access. In addition, to stand - alone coiling, these complex aneurysms require adjunctive techniques to achieve stable coil mass. Stand-alone coiling may lead to various problems like distal coil migration,

coil impingement on the parent vessel, and incomplete embolization. Currently used adjunctive techniques include balloon-remodeling technique, double/multiple microcatheters, stent-assisted coiling, flow diverter stents, neck bridging device, and shape memory polymer (SMP) expanding foam device, among others. Each technique has its own sets of advantages and disadvantages. The use of stent has inherent problems of antiplatelet use and its side effects primarily related to bleeding.<sup>1-3</sup> Similarly, balloon assistance also has problems like thromboembolism and aneurysmal rupture due to a rise in intraluminal pressure in an aneurysmal sac at the time of balloon inflation.<sup>3,4</sup>

Here we describe ten cases using intra - aneurysmal double microcatheter<sup>5-8</sup> in different settings, and

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addressing both their immediate and long - term outcome. A similar technique was first described by Baxter et al<sup>5</sup> where he described the use of one microcatheter inside the aneurysm initially. After noting the instability of the coil inside the aneurysm, he placed another coil via another microcatheter to achieve complete coil embolization. This approach achieved inner bracing of coils across the neck of an aneurysm, and hence, making it stable. Some technical modifications had been described by other authors<sup>3,4</sup> like the assistance of microcatheter or wire across the neck of the aneurysm, and the use of more than two microcatheters inside the aneurysm sac.

## 2. Materials and Methods

Ten patients were treated using the endovascular method of double microcatheter between December 2013 to September 2014. These patients presented with acute subarachnoid hemorrhage as seen on plain cranial CT scan. All patients underwent diagnostic DSA where evidence of rupture and the morphology of the aneurysm was noted. Patients were included in the study if the aneurysm is deemed 'complex' during the planning stage or at the time of coiling. Aneurysm characteristics that are deemed 'complex' include the presence of 1) wide neck ( $\geq 4\text{mm}$ ); 2) a dome-neck ratio  $\leq 2$ ; 3) unusual shapes like banana-shaped aneurysm; 4) bilobed; 5) upward direction with a wide neck, where gravity may render the coil mass to herniate out of the neck into the parent vessel; and 6) in aneurysms with tendencies to incorporate the neighboring vessel, like those at the bifurcation. All patients gave written consent for the procedure. The study protocol was approved by our hospital ethics committee.

Detailed demographic information included patient age, sex, presentation, and clinical manifestations (Hunt and Hess scale). Morphology characteristics evaluated were the size of the aneurysm, neck, height, width, diameter, tortuosity of the parent artery, and major branches originating from the neck of the aneurysm. Follow-up was done at 1, 3, 6, and 12 months. Cranial MRA was done during every follow-up. A cerebral DSA was done at least once after one month, or earlier if the patient had symptoms like headache, vomiting, any focal neurological deficit, or recurrence of previous symptoms. Angiographic results were classified using the Raymond-Roy classification system: Class I - no filling of aneurysm neck or dome; Class II - residual filling of the neck but not dome; Class III - residual filling of neck and dome.<sup>9–11</sup> Modified ranking scale (mRS) was recorded at the time of admission, discharge, and during follow up.

### 2.1. Technique

All procedures were performed in a Philips catheterization laboratory single plane without the facility of 3D

visualization. All were done under general anesthesia. Catheterization of the right femoral artery was done in all patients, except in one which required bilateral femoral artery cannulation. Both microcatheters were navigated through a single 6 F guiding catheter except in one patient with bilateral femoral cannulation where a guiding catheter and a microcatheter were navigated through each side. Either an Echelon-10 microcatheter 1.7 F 150 cm (by ev3 micro therapeutics California) with an X-pedion-10 microwire 0.010/0.25 mm 200 cm or an Excelsior SL-10 150x60 cm (by Boston scientific for Stryker Ireland) with 0.010" system x-pedion 10, transend platinum ex 10 wire was used. Based on the working angle of fluoroscopy, and the first and subsequent coil loop size, total coil volumes needed were determined.

During the procedure, two microcatheters were placed in the aneurysmal sac. The direction of these two microcatheters was kept different so that a stable coil frame could be achieved. Coils used were Targetethical ultra detachable coils stryker neurovascular, target 360 ultra detachable coils, axium detachable coil systems 3D, and helical of ev3 micro therapeutics California. Without detaching the first coil, the second coil of a smaller size was advanced at the proximal portion of the aneurysm. A stable supporting coil frame was created covering the neck of the aneurysm. After ensuring stability, the second coil was detached electrically. Subsequently, other coils were placed in the aneurysm till the aneurysm sac is fully packed. After ensuring complete stability for 5 to 10 minutes, the first coil was then detached. Stent assistance was used as a bailout procedure in the following circumstances: 1) if the double microcatheter technique failed to provide complete occlusion; 2) there was coil impingement on the neighboring vessels, or 3) when the coils seem to herniate out of the aneurysm neck. Complete embolization was defined as when the aneurysm was completely covered, including the neck, and no further coils could be pushed inside the aneurysm sac.

## 3. Results

All aneurysms were completely embolized during the double microcatheter technique until no residual filling was observed at end of the procedure. The extent of embolization was assessed using the Raymond-Roy classification system. DSA done immediately post embolization showed class I filling in 9 patients, and class II filling in 1 patient (Table 1). The mean neck diameter was 2.91 mm (range 2 to 4 mm) and the mean dome of neck ratio was 1.34 (range 0.89 to 2.14).

One patient developed a recurrence of headache after three months, but no evidence of subarachnoid hemorrhage was seen on a plain cranial CT scan. Cerebral DSA showed coil compaction with class two filling, and hence, was filled with coils using a stent to ensure stability. Modified Rankin

**Table 1:** Patient and Aneurysm Characteristics

Case	Age	Sex	Presentation	Location	Neck (mm)	Height (mm)	Width (mm)	Width to neck ratio	Technique	Angiography results Initials	Follow up angiography
1	55	F	SAH grade 3	Left supraclinoid ICA aneurysm	2.2	4	2.5	1.14	Double microcatheter	Class 1	Class 1
2	61	F	SAH grade 2	Right supraclinoid ICA aneurysm	3	4.5	3.5	1.57	Double microcatheter	Class 1	Class 1
3	58	M	SAH grade 4	ACOM aneurysm	Bilobed 4	4.5 3.5	5.2 3.3	1.3	Double microcatheter	Class 1	Class 1
4	35	F	SAH grade 2	Left supraclinoid ICA aneurysm	2.8	7.8	6	2.14	Double microcatheter	Class 1	Class 1
5	55	F	SAH grade 2	RMCA bifurcation aneurysm	3.0	5.5	3.7	1.23	Double microcatheter	Class 1	Class 1
6	55	F	SAH grade 2	LMCA bifurcation aneurysm	2.8	3.63	3.2	1.14	Double microcatheter	Class 1	Class 1
7	45	M	SAH grade 2	LMCA bifurcation aneurysm	2.8	1.8	2.5	.89	Double microcatheter	Class 1	Class 1
8	65	M	SAH grade 1	LMCA bifurcation aneurysm	2	1.5	2	1	Double microcatheter	Class 1	Class 1
9	40	F	Headache	Supraclinoid ICA aneurysm	3.5	3.5	4.5	1.28	First double micro Second stent-assisted	Class 1	Class 2
10	67	F	SAH grade 2	RMCA bifurcation aneurysm	3.0	7.8	4.8	1.6	Double microcatheter	Class 1	Class 1

**Table 2:** Follow up Data

Case	Presentation SAH grade	mRS scale at presentation	Follow up period	mRS scale at 1 month	Follow up angiography at 1 month	mRS at 3 month	mRS at 6 month	mRS scale at 12 month
1	3	5	12 month	4/6	Class 1	3	2	1
2	2	3	12 month	2/6	Class 1	2	1	0
3	4	5	12 month	3/6	Class 1	2	1	0
4	2	3	12 month	2/6	Class 1	1	1	0
5	2	4	12 month	3/6	Class 1	2	1	0
6	2	4	12 month	3/6	Class 1	2	1	1
7	2	4	12 month	3/6	Class 1	2	1	0
8	1	3	12 month	2/6	Class 1	1	0	0
9	2	3	12 month	3/6	Class 1	2	1	0
10	2	3	12 month	2/6	Class 1	1	1	0

scale (mRS) did not show any improvement immediately after the procedure but was seen on follow up [Table 2]. There was significant recanalization angiographically and clinically in one patient, and so stent-assisted coiling was done.

### 3.1. Complications

All the patients tolerated the procedure well. There were no other procedure-related complications such as coil protrusion and coil migration, thromboembolic or aneurysm rupture. There was no recurrence of subarachnoid hemorrhage during the follow-up period. One patient had coil compaction on follow up DSA, which was then managed by stent-assisted coil embolization. One patient had a small left middle cerebral artery territory infarct and was managed conservatively. Subsequent symptomatic improvement was noted.

## 4. Discussion

Use of double microcatheter technique for wide-necked intracranial aneurysm embolization has been described by various authors via different methods: either placing both microcatheters in the aneurysmal sac or using one microcatheter for coiling and another one for support across the neck of an aneurysm.<sup>6,12,13</sup> This approach is useful in cases of aneurysms with wide neck, banana-shaped, upward-directed, bilobed, or located in the supraclinoid C2 internal carotid artery, anterior communicating artery, and MCA bifurcation (where there is more tendency to incorporate the vessel origin at the base of aneurysm). In cases of elongated or banana aneurysms in which coiling is feasible, positioning of first framing coils through piecemeal subsequent coiling can be done. However, there remains the problem of coil prolapse in the parent artery, loose packing, or having a significant neck remnant.

Also, this technique is particularly helpful in a limited setting where the facility of biplane or 3D was not available. One can get a fair idea regarding the three-dimensional shape of the aneurysm after placement of both the coils before the coil detachment.

In case 1, we have placed the first microcatheter proximally, and the second distally, in an aneurysmal sac. There was a stable lattice formation through the entanglement of the two coils. Subsequent packing of filling coils using the second distal microcatheter achieved satisfactory aneurysm obliteration without compromising the parent artery. The first or proximal microcatheter coil was detached last, after about one hour, to confirm stable coil mass. A supraclinoid C2 internal carotid artery aneurysm which is wide-necked and/or upward-directed is technically easier for microcatheter navigation, and they provided stable coil mass as seen in case 2.

In anterior communicating artery aneurysms, which are also wide-necked and directed upward, placing a stent is not feasible due to local anatomical challenges like tortuosity of adjoining vessels and space constraints for stent placement. We have coiled this wide-necked, bilobed, ACOM aneurysm using a double microcatheter technique. Putting a microcatheter in two lobes provides more stability to final coil mass, and shortens overall procedure time. Entanglement of coils will form a more stable lattice, and coils from the first microcatheter, in the end, will keep the option of reshaping the first coil in case of prolapse as seen in case 3. MCA bifurcation aneurysms are complex because of the incorporation of vessel origin at the aneurysm. Therefore, a sub-optimal, dense packing avoiding the vessel origin will result in a stable and secure aneurysm rather than producing an angiographic cosmetically - perfect result with morbidity (case 6). The use of stent coiling increases the risk of hemorrhagic complications.<sup>11,14</sup> It may also be difficult to navigate the stent.<sup>3</sup> Theoretically, limitations of this technique include the higher risk of coil migration, and suboptimal packing, which can lead to recanalization and subarachnoid hemorrhage. If there is suboptimal packing, one can do a closer follow-up clinically and angiographically. Raymond J. et al<sup>3</sup> cited higher rates of recanalization with very low aneurysm rebleeding rate in the endovascular treated aneurysm. If there is recanalization during follow - up, one may do more robust procedures like stent-assisted coiling, and use dual anti-platelet drugs more liberally once outside the acute setting.

This technique requires more detailed observation and more time for embolization despite being a safe and simple procedure. However, this technique can achieve complete embolization of the aneurysm in many complex aneurysms, especially in centers with limited resources and at a significantly lower cost. However, generalizability is limited due to the small sample size and a short follow-up period of this study.

## 5. Conclusion

Compared to other methods of treating these subsets of aneurysms, this modified intra-aneurysmal double catheter technique is efficacious, safe, cost-effective, and not technically demanding. However, further studies with a higher number of patients and longer follow-up are needed to draw definite conclusions.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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