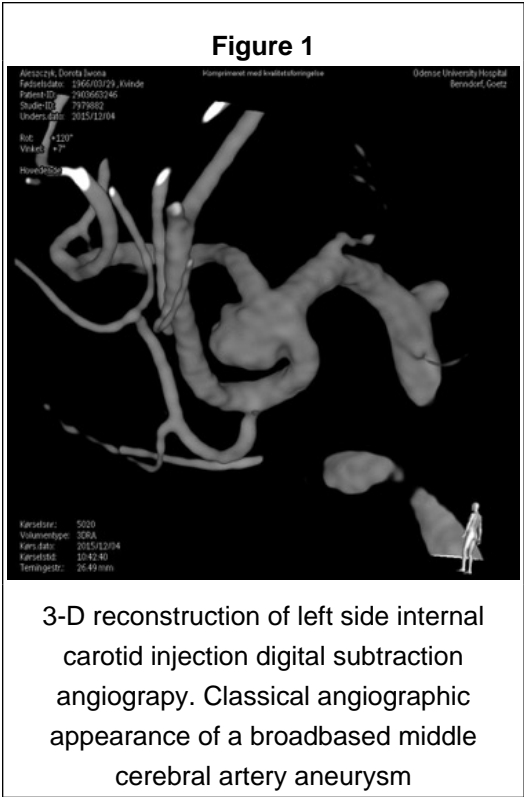


Introduction

Middle cerebral artery (MCA) aneurysms are generally considered suitable for microsurgical clip ligation, but recent introduction of various intraluminal stents might shift the treatment paradigm towards endovascular treatment. We report our single center experience with both modalities for treatment of unruptured MCA bifurcation aneurysms.



Methods

Patients treated for unruptured MCA bifurcation aneurysm from 2011 to 2016 were retrospectively included. Fusiform, complex, and giant aneurysms >25mm were excluded. Patients were stratified into a microsurgical and an endovascular group. The latter was subdivided into a stent assisted coiling group, flow diverting stent group, stent-only group, and coil-only group. Aneurysm characteristics, 15 month occlusion rate and clinical outcome were recorded. Raymond Class I occlusion and mRS=1 were defined as successful outcome.

Table 1						
	Microsurgical clipping	Total endovascular treatments (EVT)	Stent assisted coiling (SAC)	Flow Diverting Stent (FD)	Stent only (non-flow diverter)	Coil only
Patient characteristics						
No. of patients	28*	54*	24**	23**	5	3
Female to male ratio	2/1	4/1	5/1	2/1	5/0	3/0
Median age, years (IQR)	53 (45-61)	57 (52-64)	60 (54-65)	54 (46-54)	57 (55-63)	55 (51-58)
Aneurysm characteristics						
No. of aneurysms	29	56	24	24	5	3
Median size, neck/dome, mm (IQR)	4.3 / 5.3 (4.0-5.0 / 4.5-7.0)	3.8 / 4.7 (3.0-5.0 / 3.6-7.5)	3.8 / 4.7 (3.1-4.3 / 3.6-8.0)	4.3 / 5.0 (3.0-6.0 / 4.0-8.9)	2.0 / 2.9 (2.0-3.5 / 2.2-4.5)	2.1 / 4.5 (2.1-3.2 / 4.2-4.8)
Neck/dome ratio	0.81 (0.67-1.0)	0.81 (0.54-1.0)	0.81 (0.56-1.0)	0.86 (0.34-1.25)	0.69 (0.67-0.8)	0.47 (0.44-0.82)
IQR: Interquartile range						
* One patient, receiving both microsurgical and endovascular treatment, is included in both groups.						
** One patient, receiving both stent assisted coiling and flow diverter treatment, is included in both groups.						
Patient demographics and aneurysm characteristics for 81 patients treated for unruptured middle cerebral artery (MCA) aneurysms						

Results

Eighty-one patients with eighty-five aneurysms were included. 29 aneurysms were included in the microsurgical group, 56 aneurysms were included in the endovascular group. 24 aneurysms were treated with stent assisted coiling, 24 aneurysms with flow diverting stents, 5 aneurysms with a non-flowdiverting stent, 3 aneurysms with coils only. No difference in aneurysm characteristics was found, but neck/dome ratio in the coil-only group was smaller than the other endovascular subgroups (p=0.08). Raymond Class I was achieved in 100% and 69.4% of the aneurysms in the microsurgical and endovascular group respectively. In the latter group occlusion rate was 84.2% for stent assisted coiling, 65.2% for flowdiverters, 0% for the stent-only group, and 100% for the coil-only group. These differences were significantly inferior to microsurgical clip ligation except for the stent assisted coil group (p=0.064) and coil-only group (p=1.00). Favorable clinical outcome was achieved in 93% and 98.2% of the patients in the microsurgical and endovascular group respectively (p=0.58). No patient had an mRS >2 after treatment.

Table 2						
	Microsurgical clipping	Endovascular treatments (EVT)	Stent-assisted coiling (SAC)	Flow diverter	Stent only	Coils only
Angiographic outcome						
Median follow-up, months (IQR)	6 (5-7)	15 (13-18.5)	14.5 (13-19)	15 (13-18.5)	19 (16.5-22)	10 (9-12)
Complete occlusion, n	27/27	34/49	16/19	15/23	0/4	3/3
Rate of occlusion, % (95% CI)	100% (87.9-100%)	69.4% (57.3-82.8%)	84.2% (57.8-92.5%)	65.2% (45.2-83%)	0% (0-45.7%)	100% (47-100%)
P-value compared to microsurgical clipping		0.001	0.064	0.001	<0.001	1.000
Clinical outcome						
Median follow-up, months (IQR)	25 (17-60) n=27	38 (31-49) n=38	32 (24-38) n=17	53.5 (46-65) n=15	36 (34-38.5) n=4	38.5 (29.3-47.8), n=2
mRS 0	15 (55.6%)	24 (68.6%)	11 (64.7%)	8 (53.3%)	2 (50%)	1 (50%)
mRS 1	10 (37%)	10 (28.6%)	6 (35.3%)	6 (40%)	2 (50%)	1 (50%)
mRS 2	2 (7.4%)	1 (2.9%)	0 (0%)	1 (6.7%)	0 (0%)	0 (0%)
P-value (for mRS ≤1)		0.58	0.51	1.000	1.000	1.000
Angiographic and clinical outcome for microsurgical or endovascular treatment of 85 middle cerebral artery aneurysms						

Conclusion

Microsurgical clip ligation provides superior obliteration rate compared to endovascular treatment with comparable clinical outcome in the treatment of uncomplicated MCA bifurcation aneurysms.

Learning objectives

Microsurgical clipping is a viable option in the treatment of unruptured middle cerebral artery bifurcation aneurysms compared to endovascular treatment.