Analysis of Relationship Between Perioperative Stroke and Emboli-Protection Devices in the Procedure of Carotid Artery Stenting

Yasuhiro Kawabata MD
[Institution]
National Hospital Organization Hospital Kyoto Medical Center

Abstracts

•Introduction: We routinely used balloon type embolus protection devices (EPDs) during carotid artery stenting (CAS), then changed to filter type EPDs. Presently, we select from a variety of EPDs, including the flow-reversal type, according to the findings of magnetic resonance imaging (MRI) of the carotid plaque. We examined the risk of periprocedural cerebrovascular accident in patients undergoing CAS during these three periods.

•Materials and methods: We reviewed the clinical outcomes of 119 patients who underwent CAS with an EPD for 130 hemispheres/arteries . Carotid wall MRI was performed preoperatively in 36 patients (28%), and the signal intensity of the plaque on T1-weighted images was determined. In the third period, the EPD was selected based on the plaque morphology and the presence of neurological symtoms. We treated 65, 29, and 36 lesions in the first, second , and third periods, respectively.

•Results: Perioperative stroke was diagnosed in six patients (five ischemic strokes and one hemorrhagic stroke). The 30-day transient ischemic attack (TIA) rate was 5.4% and the stroke rate was 4.6%. Three out of six (50%) strokes, and six out of seven (86%) TIAs were due to distal emboli. The 30-day TIA or stroke rate caused by distal emboli was 9.2%, 6.9%, and 3.1% in the first, second and third periods, respectively (p=0.15).

•Conclusions: Periprocedural TIAs and strokes due to distal emboli can be minimized when an EPD is selected based on MRI of the carotid plaque. However, half the periprocedural strokes observed in our series were not prevented despite the use of EPDs.

Materials and Methods

summary of cases

	distal balloon-type	filter-type	proximal occlusive balloon type	total
1st (1999~2008)	63	0	2	65
2nd (2008~2011)	0	25	4	29
3rd (2009~)	7	19	10	36

Since1999, EPDs have been used during carotid artery stent placement in 130 arteries for 119 patients at four institutions.

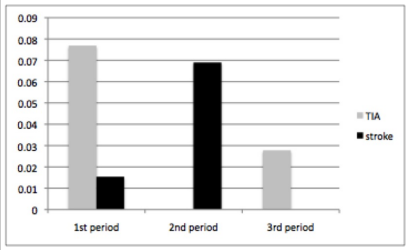
Table1

filter type EPD	asymptomatic, fibrous and calcified lesion, or poor collateral circulation
distal occlusive balloon EPD	symptomatic, fatty lesion, and good collateral circulation
proximal occlusive balloon EPD	symptomatic, high signal on T1weighted imaging, and long lesion (>20mm)

Tailored CAS: protocol for patient - and lesion-specific selection of the EPD

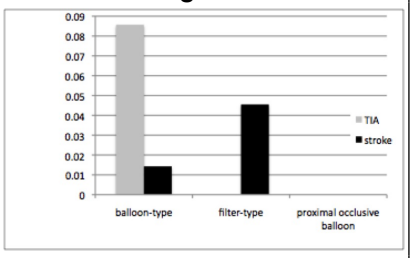
Results

Figure1



Perioperative TIA and stroke rate caused by distal emboli (period)

Figure2



Perioperative TIA and stroke rate resulting from distal emboli (EPD)

Table 2

period	age	sex	presentation	EPD	type of stroke	location	cause
1	70	female	asymptomatic	GuardWire	major stroke	contralateral	aortogenic emboli
1	77	male	symptomatic	GuardWire	major stroke	ipsilateral	distal emboli
1	69	male	symptomatic	Naviballoon	TIA	ipsilateral	distal emboli
1	77	male	asymptomatic	GuardWire	TIA	contralateral	hemodynamic
1	76	male	symptomatic	GuardWire	TIA	ipsilateral	distal emboli
1	74	male	symptomatic	GuardWire	TIA	ipsilateral	distal emboli
1	81	male	symptomatic	GuardWire	TIA	ipsilateral	distal emboli
1	76	male	symptomatic	GuardWire	TIA	ipsilateral	distal emboli
2	84	male	symptomatic	FilterWireEZ	major stroke	ipsilateral	distal emboli
2	71	male	symptomatic	AnigoguardXP	minor stroke	ipsilateral	distal emboli
3	79	male	symptomatic	Proximal occlusion	major stroke	ipsilateral	hyperperfusion
3	74	female	symptomatic	FilterWireEZ	minor stroke	pons	lacune
3	87	female	symptomatic	GuardWire	TIA	ipsilateral	distal emboli

Summary of comlications

Discussion

Although carotid endarterectomy (CEA) has been the gold standard treatment for carotid artery stenosis, carotid artery stenting (CAS) has been accepted as a reasonable alternative in selected patients. The CREST trial showed that in patients with symptomatic or asymptomatic carotid stenosis, the risk of the composite primary outcome of stroke, myocardial infarction, or death did not differ significantly between those undergoing CAS and those undergoing carotid endarterectomy (1). However, stenting appeared to carry a higher risk of stroke in the periprocedural period, as previously reported in other randomized trials conducted in Europe (2).

Since the introduction of CAS in the 1990s, distal emboli during angioplasty and stent deployment procedures have been considered to be the major cause of perioperative stroke. Thus, various kinds of EPD have been developed to reduce perioperative stroke rate. There are currently three types of EPD on the market: distal occlusion balloons; distal filter devices; and proximal occlusion balloons. The most important advantage of the filter type EPD is that it allows cerebral perfusion to be maintained throughout the procedure; however, its most important disadvantage is that flow may become impaired after angioplasty of a vulnerable plaque, which is highly associated with periprocedural stroke. Proximal occlusive balloon type EPDs have the theoretical advantage of providing protection against embolism throughout all phases of the procedure (3). A recent randomized study examining the use of proximal occlusive balloon EPDs yielded promising results (4). Some investigators have advocated the "tailored CAS" approach, selecting an EPD according to plaque morphology and the presence of neurological symptoms (5), which may explain why the incidence of postoperative complications after CAS seems to be improving (3). In our series, we observed a trend suggesting reductions in the rates of periprocedural TIA and stroke resulting from distal emboli after adopting the tailored CAS approach. The type of EPD did not appear to significantly affect the periprocedural rate of TIA or stroke, but this might have been due to the relatively small number of cases in our cohort. Interestingly, distal balloon type EPDs were highly associated with TIA, but periprocedural stroke rate due to distal emboli was as low as 1.5%.

Two out of three flow impairment episodes observed while using filter type EPDs for CAS eventually led to stroke. Two symptomatic patients who had stroke while the use of filter type EPDs was our routine practice both had vulnerable plaques with high signal intensity on T1 weighted MRI, and long (>20 mm) lesions. As Tanemura and colleagues remarked (6), signal intensity ratio and plaque volume are the most important predictors of cerebral embolism during or after CAS.

Conclusions

Perioperative TIAs and strokes due to distal emboli can be minimized when an EPD is selected based on the findings of MRI of the carotid plaque. However, half the perioperative strokes observed in our series were not prevented despite the use of EPDs.

There was no significant difference in the incidence of adverse periprocedural events between different types of EPD. Further investigation may be warranted.

References

1.Brott TG et al. N Engl J Med 2010;363:11-23
2.Bonati LH et al. Lancet 2010;376:1062-1073
3.Bersin RM et al. Catheterization and Cardiovascular Interventions 2012;80:1072-1078
4.Ansel GM et al. Catheter Cardiovasc Interv 2010;76:1-8
5.Pieniazek P et al. Kardiol Pol 2012;70:378-386
6. Tanemura H et al. Stroke 2013;44:105-110