Percutaneous Transluminal Angioplasty for Atherosclerotic Stenoses of Intracranial Vessels

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Summary

To study the efficacy and long-term outcome of percutaneous transluminal angioplasty (PTA) with/without stent placement for intracranial atherosclerotic stenoses, we reviewed our treated cases retrospectively. Between May 1992 and October 2003, PTA with/without stents was performed in 64 intracranial and skull base vessels in 62 patients, including 24 middle cerebral arteries, 16 internal carotid arteries, 13 vertebral arteries, and 11 basilar arteries. PTA was technically successful in 55 vessels (86%). However, four vessels (6%) failed to achieve satisfactory dilatation.

We encountered five periprocedural strokes as symptomatic complications, for a mortality rate of 4.7% and a morbidity rate of 3.1%. All the patients with stent placements survived angioplasty without any complication. In the clinical follow-up available for one week to 11.5 years (mean, 4.7 years), there were three strokes related to the treated vessels.

The annual stroke rate in the affected territory was estimated at 1.2% per year. According to these results, PTA for intracranial atherosclerotic stenoses seems to be a beneficial therapy for immediate anatomical results and long-term stroke prevention. Stent-assisted PTA could help patients achieve successful dilatation and avoid complications.

Introduction

Patients with atherosclerotic stenoses of cerebral circulation have significant morbidity and mortality rates. Recent advancement of endovascular technology enables us to treat these lesions. Concerning the extracranial carotid artery stenoses, there are many reports about stenting with percutaneous transluminal angioplasty (PTA)^{1,2}, and some randomized studies comparing carotid artery stenting and carotid endarterectomy are in progress^{3,4}. However, PTA for intracranial atherosclerotic lesions remains controversial.

The purpose of this study is to present our experience using PTA with/without stents and to evaluate the long-term efficacy of this treatment for intracranial atherosclerotic lesions.

Subjects and Methods

Between May 1992 and October 2003, PTA with/without stents was performed in 64 intracranial and skull base vessels in 62 patients. There were 41 men and 21 women aged 48 to 84 years (mean age, 66 years). Selection criteria for the therapy included (1) a symptomatic lesion such as a transient ischemic attack or a minor stroke considered to be directly responsible for the stenotic vessel; (2) at least 60% stenosis of one intracranial or skull base vessel;

Figure 1 The basilar artery is completely occluded.

and (3) haemodynamic compromise due to minimum collateral flow or proved by a cerebral blood flow study such as single photon emission tomography. Twenty-four patients had

Figure 2 The recanalized basilar artery shows residual severe stenosis.

middle cerebral artery stenoses, 16 had internal carotid artery stenoses, 13 had vertebral artery stenoses, and 11 had basilar artery stenoses.

All patients were administered aspirin, ticlopidine, cilostazol, or their combination prior to the procedure to prevent thromboembolic complications. All patients were treated under general or local anesthesia with a Stealth or Fastealth angioplasty balloon catheter (Boston Scientific) or a Gateway angioplasty balloon catheter (Boston Scientific) through a 6F-guiding catheter placed in the cervical carotid or the vertebral artery. Six patients including two with basilar artery stenoses and four with vertebral artery stenoses received S670 coronary stent (Medtronic) placement after the balloon angioplasty.

An illustrative case

This 77-year-old woman with a history of episodic vertigo suddenly developed consciousness disturbance. Angiography showed basilar artery occlusion (figure 1). Immediate local intra-arterial fibrinolysis with urokinase recanalized the basilar artery with significant residual stenosis (figure 2). PTA using a Gateway balloon catheter (Boston Scientific) followed, and relieved the stenosis (figure 3).

The patient recovered completely without any neurological deficits. The follow-up angiography obtained 3 months later showed restenosis of the basilar artery (figure 4). This lesion was treated with a 3.5 x 9-mm S670 coronary stent (Medtronic) (figure 5). The follow-up angiography after stent-assisted PTA revealed no residual stenosis.

Results

PTA was technically successful in 55 vessels (86%). However, four vessels (6%) failed to achieve satisfactory dilatation due to elastic recoil or asymptomatic dissection. We encountered five periprocedural strokes as symptomatic complications, including two patients with vessel dissection, two patients with subarachnoid haemorrhage, and one patient with perforator occlusion. Consequently, three patients died and two patients recovered completely, for a mortality rate of 4.7% and a morbidity rate of 3.1%. All the patients with stent placements survived angioplasty without any complication. Angiographic follow-up results

Figure 3 The residual stenosis is successfully treated with balloon angioplasty.

Figure 4 The lesion treated by the balloon angioplasty shows restenosis in the follow-up angiogram.

were available in 37 patients. Twenty-nine patients (78%) showed no restenosis, while eight patients (22%) suffered significant restenosis.

In the clinical follow-up available for one week to 11.5 years (mean, 4.7 years), there were three strokes related to the treated vessels. The annual stroke rate in the affected territory was estimated at 1.2% per year. During the same period, there were 13 deaths, including ischemic heart disease in four patients, diabetes mellitus in three patients, and infectious disease in two patients.

Discussion

Patients with symptomatic stenosis of intracranial vessels have significant morbidity and mortality rates. The EC/IC Bypass Study Group reported an annual stroke rate of 8% to 10% for patients with stenosis on the carotid siphon or middle cerebral artery with medical treatment^{5,6}. The Warfarin Aspirin Symptomatic Intracranial Disease study group documents for patients with symptomatic stenosis in the posterior circulation reported that annual stroke rates in the same territory of the stenotic artery were 7.8% and 10.7% for the vertebral artery and the basilar artery, respectively⁷. A recent published report regarding the med-

ical treatment for symptomatic vertebrabasililar stenosis showed the risk of recurrent stroke was 10.9% per 100 patient-years, and the rate of recurrent stroke and/or death was 24.2% per

Figure 5 The restenosis is dilated with a 3.5 x 9-mm S670 coronary stent (Medtronic) placement.

100 patient-years⁸. These studies highlight the poor stroke-free survival with symptomatic intracranial stenosis. However, surgical revascularization using extracranial to intracranial anastomosis for symptomatic anterior intracranial stenosis does not have proven efficacy compared with medical therapy⁶. Therefore, novel therapy such as endovascular treatment is anticipated.

In this study, we found that PTA with or without stents seems to be a beneficial therapy for immediate anatomical results. Concerning the long-term stroke prevention after PTA, Marks et Al had reported an annual stroke rate of 3.2% appropriate to the territory of PTA with the mean follow-up time of approximately three years⁹. In our study showing the longest clinical follow-up after PTA for intracranial stenosis with a mean follow-up period of 4.7 years, there were three strokes in the territory of PTA, giving an annual stroke rate of 1.2%, in spite of the significant angiographical restenosis rate of 22%. These data suggest that PTA is effective for long-term stroke prevention.

The reported incidence of morbidity and mortality of PTA for intracranial vessels ran-

ges from 5% to 33%⁹⁻¹³. We encountered technical failures and complication due to recoil, dissection, and perforator injury with the morbidity and mortality rates of 3.1% and 4.7%, respectively, for patients receiving balloon angioplasty alone. Recent advancement of endovascular technology makes it possible to introduce the stents for intracranial atherosclerotic lesions¹⁴⁻¹⁶. Advantages of stent-assisted angioplasty include the prevention of dissection and recoil with a better angiographic result, which also could prevent symptomatic complication and restenosis. We had performed stent-assisted angioplasty for the latest cases, including two basilar artery stenoses and four vertebral artery stenoses with coronary stents. The results of these cases were favorable without any technical complications.

Conclusions

PTA for intracranial atherosclerotic stenoses seems to be a beneficial therapy for immediate anatomical results and long-term stroke prevention. Stent-assisted PTA could attain successful dilatation and avoid complication.

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