脳卒中の外科 20：45～49, 1992

Original Article

Percutaneous Transluminal Angioplasty for the Acute Thrombotic Occlusion of the Middle Cerebral Artery

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急性期中大脳動脈血栓症に対する Percutaneous Transluminal Angioplasty

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要 旨：新しい single-lumen の balloon catheter を使い，59歳の男性の急性期中大脳動脈血栓症に対して percutaneous transluminal angioplasty (PTA) を行った．急性期脳血栓症に対する PTA の適応（特に発症からの時間，側副血行路の発達，臨床症状の重症度に関して），手技，有効性の確立には，さらに経験を積む必要があると考えられる．

Summary：Percutaneous transluminal angioplasty, in a 59-year-old man, for the acute thrombotic occlusion of the middle cerebral artery using a new single-lumen balloon catheter system is described. This is a preliminary report of a procedure that needs further evaluation as a treatment modality.

Key words:
- angioplasty
- thrombosis
- middle cerebral artery
- interventional neuroradiology

Introduction

Since the pioneering efforts by Grüntzig *et al*[1] to dilate atherosclerotic coronary artery using a percutaneous transluminal balloon catheter, wider applications of this technique have come into vogue.

Opportunities to treat cerebral ischemia in the very acute stage are increasing. Our report is possibly the first describing percutaneous transluminal angioplasty (PTA) for acute thrombotic occlusion of the middle cerebral artery (MCA) using a new single lumen catheter.

Catheter Description (Fig. 1)

The Stealth dilatation catheter (Target Therapeutics, Los Angeles) is a singe-lumen balloon catheter, which is used in conjunction with the valve-wire and the hemostatic sidearm adapter (Tuohy-Borst type) to seal off the distal end of the balloon for inflation. The balloon is designed to inflate to a specified diameter and length at a working pressure of 60–80 psi. There are two types of catheters: one is used with occlusive valve engaged inside the balloon: another is used with occlusive valve engaged outside the balloon. The balloon

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catheter used in this report is the latter type. The catheter is 150 cm in length with a diameter of 3.5 fr. and the valve-wire is 0.014 inch in diameter and 175 cm in length. The balloon at the tip of the catheter is 1.5 cm in length and its diameter is 3 mm.

After occlusion of balloon using the valve-wire, the balloon is inflated using a gauged inflator with pressure not more than 80 psi (5.4 atm).

Case Report

A 59-year-old man was referred, 7 hours after sudden onset of left hemiparesis and behavior disturbance. On admission (August 28, 1990) he was found to be disoriented with left hemiparesis, hemianesthesia, and left homonymous hemianopsia. Both past and family histories were not contributory. Laboratory data, including an electrocardiogram were normal.

Computerized tomography (CT) was normal. Transfemoral carotid angiography, performed immediately after admission, showed complete obstruction of the right MCA at its M_1 portion (Fig. 2). Both, the left carotid and right vertebral angiography showed poor collateral flow to the right cerebral hemisphere (Fig. 3). From available history and angiographic findings it was not possible to differentiate between thrombosis or embolism.

Under local anesthesia and systemic heparinization (5,000 I.U.), the tracker-18 catheter (Target Therapeutics, Los Angeles) was navigated through a guiding catheter (6.0 fr.) to the obstruction site within the right MCA. At this stage we thought thrombosis to be more likely than embolism because of poor collateral flow. Six thousand I.U. of urokinase were slowly injected through the catheter. Since the

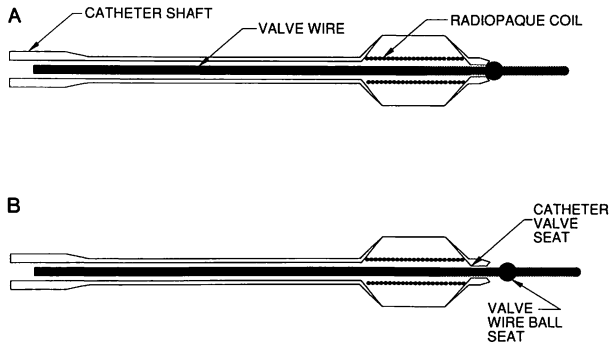

Fig. 1 Illustration of the Stealth dilatation catheter. **A:** Inflated state. The valve-wire is occluding the balloon at the distal end of the balloon. **B:** Deflated state.

urokinase flowed mostly to the right anterior cerebral artery, this procedure was abandoned. Through the guiding catheter, the Stealth dilatation catheter was then navigated to reach the right MCA and the valve-wire was advanced, slowly, through the occlusion site to the M_2 portion. Over this guidewire, the balloon catheter was also advanced through the occlusion site. Pulling the valve-wire back, the balloon catheter was occluded and inflated with 5 atmospheres pressure using a gauged inflator for 20 seconds. During inflation, this patient complained of severe right temporal pain, but there was no neurological worsening. This inflation resulted in recanalization of the MCA. The MCA was moderately irregular without obvious distal embolization (Fig. 4). Inflation was performed only once since it was thought that enough flow was established. Repetitive inflations could carry a risk of distal embolization. The entire procedure was completed within 9 hours of the onset of the ictus.

Following the procedure, hemiparesis and dis-

Fig. 2 Right carotid injection showing complete occlusion of the middle cerebral artery at its M_1 portion (*arrow*). **A:** A-P view. **B:** Lateral view.

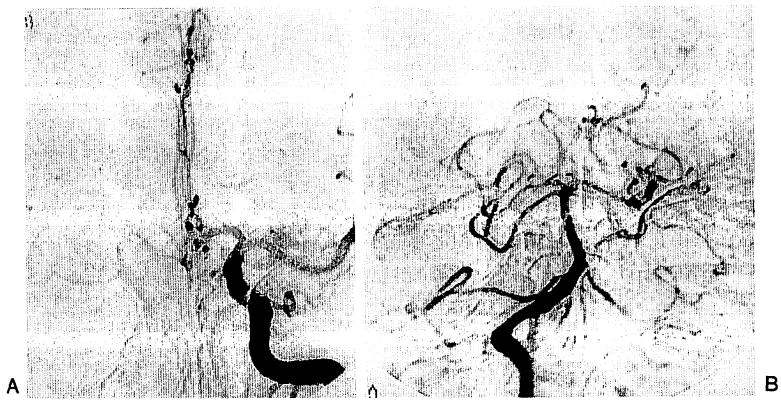

Fig. 3 Left carotid injection **(A)** and right vertebral injection **(B)** show poor collateral circulation to the right hemisphere.

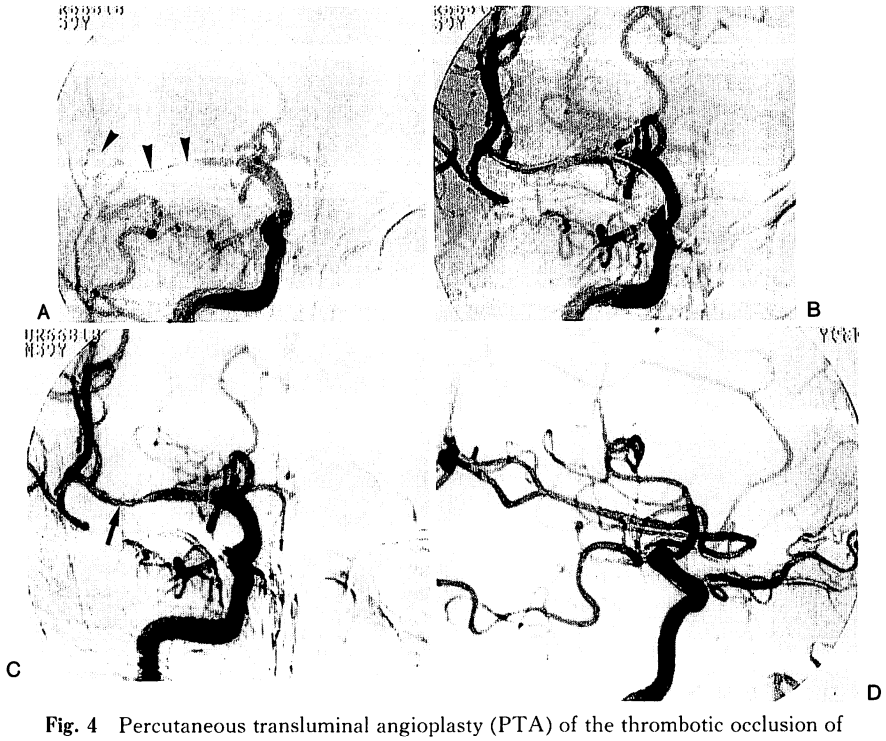

Fig. 4 Percutaneous transluminal angioplasty (PTA) of the thrombotic occlusion of the right middle cerebral artery using Stealth dilatation balloon catheter. **A:** The valve-wire (*arrowheads*) is advanced into the M_2 portion of the middle cerebral artery through the occlusion site at M_1. **B:** Immediately after the PTA (inflation for 20 seconds with pressure of 5 atm), the Stealth dilatation catheter is still in place in the middle cerebral artery. **C, D:** Outcome after the PTA. Moderate stenosis and wall irregularity are noted (*arrow*).

orientation improved moderately though the field defects persisted. The patient was put on heparin (5,000 I.U./day) and ticlopidine (100 mg tid). About 30 hours post-angioplasty the hemiparesis worsened possibly during sleep. Since the deficit was detected rather late, further intervention was not attempted. Magnetic resonance imaging performed 5 days after deterioration showed thrombosis at right M_1 (Fig. 5).

A month later, he was alert with moderate hemiparesis. His hemianopsia remained unchanged. CT showed a low density area at the water-shed region between the right temporal and occipital lobes.

Discussion

Both, diagnosis and management of cerebral ischemia during acute stages remain controversial. Though it is useful to differentiate thrombosis from embolism, this is not always possible with certainty.

Various treatment modalities like, fibrinolysis,[12] PTA, surgical removal of the thrombus,[10][11] extracranial-intracranial bypass,[11] conservative therapy etc. have been advocated for acute thrombotic ischemia. Since the clinical picture in MCA thrombosis ranges widely from being asymptomatic to being fatal and also because the natural course is difficult to predict, the choice of a therapeutic modality becomes difficult.[4][5][8]

Sundt *et al*[9] and Higashida *et al*[2] reported angioplasty of stenotic basilar artery through a surgically exposed vertebral artery. PTA for vasospasm following subarachnoid hemorrhage has been reported.[3][6][13] While PTA for vasospasm needs soft balloon catheter inflated at low pressure, that for atherosclerotic vessels needs inflation at high pressure. The Stealth dilatation catheter has a graded shafts tiffness allowing the catheter to track over the subselectively placed valve-wire. This catheter can be placed into the intracranial vessels and its balloon can be inflated with relatively high pressure (5 atm), allowing PTA of atherosclerotic vessels.

Reporting in atherosclerotic MCA stenosis, Purdy *et al*[7] found occurrence of restenosis following PTA using silicone balloon catheter. In our case re-occlusion occurred 30 hours after PTA. This could be related to the dosage of heparin and/or incomplete PTA. On certain occasions the possibility of PTA occluding the perforators as reported by Higashida *et al* should be kept in mind.[2]

Besides improving the technique of PTA for cerebral vessels it would be important to standardize the pre-, intra-, and post-PTA management protocols. The role of anticoagulants and antiplatelet drugs would also need critical evaluation. Information from coronary angioplasty could be useful for PTA of cerebral vessels. Patient selection criteria, including indications for PTA and its timing in relation to cerebral arterial thrombosis is not clear. We feel that a normal CT scan in patients with poor neurological condition (unconscious, hemiplegia, aphasia) and a poor collateral flow could be good indications for PTA if the patient is seen within 6 hours of the onset of stroke.

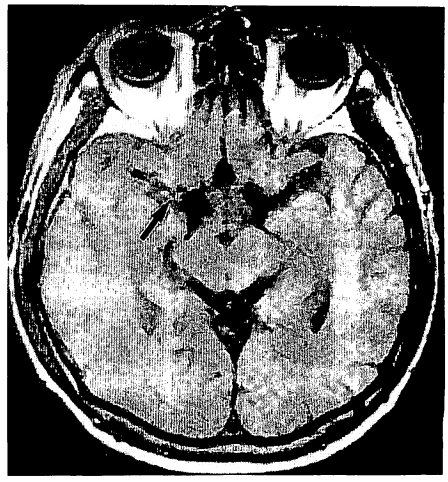

Fig. 5 Magnetic resonance imaging (T_1-weighted spinecho image) carried out 5 days after deterioration shows the reocclusion of the right middle cerebral artery. Arrow indicates the thrombus.

With refinements in techniques and improvements in management protocol, the indications for PTA would not only change but become more clear. However further experiences would be necessary to evaluate the role of PTA in the management of acute thrombotic stroke.

Acknowledgement

The authors are grateful to Dr. V.K. Khosla, MS, Mch, MNAMS, addl. Prof., Dep. of Neurosurgery, Post Graduate Institute of Medical Education and Research, Chandigarh, India for his valuable advise in preparation of this manuscript.

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