Intracranial Thrombolysis via a Catheter Embedded in the Clot

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We treated a patient with acute stroke by clot lysis with urokinase. The drug was administered via an arterial catheter that had been positioned in the middle cerebral artery with the catheter tip embedded in the thrombus. The use of a microcatheter that is not flow-directed was essential to performing this procedure. Thrombolysis was successful, but an underlying high-grade vascular stenosis caused rethrombosis. Nevertheless, the techniques used in treating this patient are relatively uncomplicated. They make intracranial arterial thrombolytic drug infusions practical and are an important subject for further clinical evaluation. (Stroke 1989;20:1578–1580)

A 74-year-old man presented with an acute stroke. After 2 days of systemic heparinization he became acutely worse, and we attempted to lyse the clot in the middle cerebral artery (MCA) by infusing urokinase directly into the clot.

Case Report

This man was referred to us for evaluation of sudden left-sided weakness associated with slurred speech. Systemic heparinization was instituted. Angiography demonstrated a high-grade right MCA stenosis, with collaterals from anterior temporal branches reconstituting the distal MCA territory. Over the next 2 days the patient improved slightly, but on Day 2, despite heparinization, he became acutely weaker and neglected his left side and had a right gaze preference. Head computed tomography (CT) did not demonstrate either a hemorrhage or an infarct, and angiography was repeated. This second angiogram revealed a complete occlusion of the right MCA at the site of the previously demonstrated stenosis (Figure 1). The right MCA was catheterized for the purpose of thrombolysis. A Tracker-18 microcatheter (Target Therapeutics, Los Angeles, California) was positioned in the proximal MCA (Figure 2, top left). In this position, urokinase (ABBokinase, Abbott Laboratories, North Chicago, Illinois) was infused at a rate of 1,000 units/min for 20 minutes. No clinical or angiographic changes occurred during this initial infusion; therefore, the rate was increased to 1,500 units/min for 20 minutes and subsequently to 2,000 units/min for 20 minutes, still with no changes. The microcatheter was then advanced firmly into the thrombus. After 20 minutes in this position (rate 2,000 units/min), significant lysis became apparent (Figure 2, top right). The infusion was continued, and the catheter was slowly advanced during the next 20 minutes until the lumen became reconstituted (Figure 2, bottom left). A short stenosis remained, however, near the bifurcation of the MCA despite an additional 20 minutes of infusion. A microguidewire could be advanced across the stenosis, but the microcatheter could not (Figure 2, lower right). An internal carotid angiogram at the conclusion of the procedure and within 5 minutes of removing the microcatheter showed that the vessel had reoccluded. The patient remained unchanged throughout the entire procedure, including the short period of approximately 30 minutes when the main MCA was open. The total amount of urokinase infused was 210,000 units over approximately 2½ hours. Follow-up CT scans never demonstrated any hemorrhage.

Discussion

Thrombolytic agents such as streptokinase, urokinase, and tissue plasminogen activator are successfully used in coronary and peripheral arteries to treat thromboembolic occlusive disease.1–8 A few cases have been reported in which a vertebral, basilar, or carotid artery has been successfully opened by intrarterial perfusion with thrombolytic agents.9,10 Another study showed success in lysing MCA thromboses with superselective intracranial catheterizations.11 A reduced area of infarction with less neurologic deficit has been produced in baboons treated with arterial infusions of urokinase following experimentally induced MCA thrombosis.12 However, these thrombolytic agents have not been generally advocated as a therapeutic choice in treating acute stroke patients, partly because the intracranial arterial infusion of such agents has not been readily available.
The technique we used is direct catheterization of the MCA using a newly developed catheter system that has proven useful in intracranial catheterizations for the treatment of vascular malformations. This system is considerably easier to use than the flow-directed calibrated-leak balloon catheters that have been the mainstay of intracranial catheterizations until now. Using the new system, catheters can be directed into low-flow areas and can even be directed against the flow. Furthermore, the new system offers a significant advantage over flow-directed systems as a catheter can be embedded firmly into a thrombus with relative ease. In peripheral vessel thrombolysis, such an approach has proven more efficacious than simply placing the catheter tip near the clot, and the system seemed to be more effective in this case as well.

The major theoretical advantage of arterial infusions in general is that the systemic effects of thrombolytic agents are minimized. For example, intracranial hemorrhage from systemic intravenous administration of lytic agents has occurred. The major disadvantage of arterial infusions is technical: the procedure requires a trained interventionalist and has the usual risks associated with angiography.

In our patient an underlying high-grade stenosis of the MCA remained and probably caused the rethrombosis. This situation appears analogous to that in coronary and peripheral vessels, where an underlying stenosis must be dilated to prevent reocclusion. We were unable to advance the microcatheter across the stenosis and did not have a balloon angioplasty catheter of suitable properties available to treat the stenosis. Thus, it remained. Nevertheless, the technique we used in this patient is relatively uncomplicated and should expedite intracranial arterial catheterizations for the purpose of thrombolysis.

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**References**

FIGURE 2. Superselective angiograms of middle cerebral artery (MCA) (anteroposterior views) showing progress of urokinase infusion. Top left: Initial angiogram. Microcatheter tip (arrowhead) is in proximal MCA. Occlusion (long arrow) and patent anterior temporal branch (short arrow) are well seen. Top right: Subsequent angiogram. Evidence of some thrombolysis since microcatheter tip (arrowhead) is now in more distal position (compare with top left). Bottom left: Final angiogram. MCA lumen has now been opened, but stenosis remains that impedes microcatheter tip (arrowhead). Only minimal reflux occurs into anterior temporal branch (short arrow), which was opacified easily on previous injections. Bottom right: Tip of microguidewire (long arrow) easily passed across stenosis into distal MCA, but tip of microcatheter (arrowhead) did not.


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