Mechanical Revascularization of the Brain Using the Reversal of Flow Method

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Stroke is the third cause of death and the first of major disability. It affects about 750,000 Americans every year. The only accepted and approved treatment is the use of alteplase within the initial 3 hours of the occurrence of the stroke. Beyond that window, results are not significantly different from conservative treatment and the incidence of hemorrhage increases. In situ, catheter-directed thrombolysis is more effective than the intravenous one but also has the limitation of time and the increased incidence of intracranial bleeding. Lytic therapy in middle cerebral artery (MCA) occlusions is often ineffective owing to the size of the embolus and the need for a large dose of drug administered during a long period of time. Only about 2.8% of strokes are treated by active measures. It is calculated that 40% of stroke cases are potential candidates to effective treatment.

Treatment of acute myocardial infarction has evolved from the intravenous use of streptokinase to mechanical revascularization, which is currently the treatment of choice of this condition.

Time limitations and a lack of education of physicians and patients are some of the causes of the lack of effective treatment in most of the stroke cases. Emboli are seen more frequently than in situ thromboses in the intracranial vasculature; just the opposite is true of the coronary territory, in which in situ thromboses are the rule. Mechanical revascularization of the brain is possible in selected cases using special wires, balloons, and retrieval devices. Distal embolization of particles resulting from a manipulation of the occluding material occurs almost regularly after attempts of mechanical treatment of MCA occlusion. Nakato noticed that in 10 of 15 cases of MCA occlusion treated mechanically, distal embolization ensued with undesirable consequences.

In February 2003, we presented our experience in 83 patients in whom we used the cerebral protection device during carotid stenting, described by us as a reversal of flow system. Those patients were evaluated using transcranial Doppler monitoring and dynamic intracranial angiography. Reversal of flow in the MCA was achieved in 64% of the patients when the system was applied and the connection of the side port of the venous line was established. In 87%, active aspiration produced the described effect, but in 13% of the patients, ancillary maneuvers were needed. Ancillary maneuvers consisted of compression of the contralateral CCA to abolish anterior communicating artery flow from the contralateral side. That flow maintained MCA antegrade flow. In one case, external compression of the vertebral artery was needed to interrupt antegrade flow in the MCA.

We were able to stop the antegrade flow and produce retrograde flow in the MCA in every patient we studied. The hypothesis is that by interrupting the antegrade flow and promoting retrograde flow, we can eventually achieve mechanical revascularization of the MCA (M1 or M2) without producing distal embolization and facilitating the removal of particles by aspiration. The two main potential advantages of mechanical revascularization over lysis could be fewer complications with bleeding and a faster reestablishment of flow in the artery. The time window for treatment of acute stroke could eventually be longer and more patients could be included. In some cases, the use of general Pentothal anesthesia and local hypothermia could be considered.