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Case Report

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CERVICAL ICA STENOSIS WITH GOOD COLLATERAL CIRCULATION: OPTIONS FOR MANAGEMENT

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ABSTRACT

Background: Management of acute ischemic stroke due occlusion of the cervical ICA remains to be ill-defined. The rate of recanalization using standard therapy from guidelines remains low. Generally good prognosis of patients corelates with good collateral circulation. However, studies on augmentation of collateral blood flow have not been successful in demonstrating clinical benefit. Here we illustrate a case of a patient where current standard therapy and effect of collateral circulation are inadequate to achieve a good outcome. A patient with a stroke due to a cervical ICA stenosis, with good collateral flow noted on angiography, was managed medically adhering to the current guidelines. However, patient still evolved with a full blown stroke. Possible explanations for this include hemodynamic stability and distal embolization due to partial thrombolysis.

Conclusion: The current management for the subset of patients with acute ischemic stroke caused by stenosis or occlusion of the cervical ICA, and with good collateral circulation, needs to be examined further. The use of intravenous thrombolysis, antiplatelets, and statin are not enough to achieve good outcomes. The utility of IV rt-PA or mechanical thrombectomy this subset of patients need further research.

Keywords: Collateral Circulation, Cervical ICA Stenosis, Stroke

INTRODUCTION

Carotid atherosclerosis accounts for a substantial amount of all strokes, and several trials have shown the relationship between the risk of stroke and extent of a symptomatic internal carotid artery (ICA) stenosis. Patients with a recently symptomatic carotid artery disease are at in increased risk for stroke, and the risk is tripled in patients with compromised cerebral hemodynamics and poor collateral blood flow**(1)**. Recently, the presence of collateral blood flow has been widely recognized to have significant effects on the course of ischemic injury, stroke severity, therapeutic opportunities, recanalization, reperfusion, hemorrhagic transformation and neurological outcomes after stroke **(2,3)**.

During the natural course of ischemic stroke, opening of collaterals depend on several hemodynamic, metabolic, and neural mechanisms that seek to stabilize cerebral blood flow when the principal blood

supply fails**(3)**. The Circle of Willis is considered the primary collateral flow, using the anterior communicating artery (ACom) or the posterior communicating artery (PCom) to provide additional blood flow coming from the contralateral ICA, the vertebro-basilar system, or both. Collateral flow coming from the external carotid artery and the leptomeningeal collaterals are considered as secondary collateral routes, which are recruited only when the primary collaterals fail**(1)**.

Collaterals have then become therapeutic targets but a significant positive outcome for acute ischemic stroke from controlled trails continues to be elusive. Here we describe the clinical course of a patient (after approval by our institution's ethics review board, and with informed consent) with cervical ICA stenosis with good collateral flow, discuss options for management and potential outcomes.

Case Report

A 55 year-old male, known hypertensive and diabetic, smoker, with history of transient weakness of the right upper extremity 10 days prior. Cranial MRI then did not show acute infarct. Cerebral angiography (Figure 1) revealed a mild stenosis of the contralateral cervical ICA. Patient was managed medically, with anti-platelets and statin. The patient at the time of admission presented with aphasia, and right sided face, arm, and leg weakness. Cranial MRI DWI (Figure 2) showed restricted diffusion on the left frontal lobe. MRA (Figure 2) showed absent flow signals in the left ICA origin, and moderate narrowing on the left common carotid artery. Intravenous thrombolysis was done. CerebralDSA (Figure 3) showed severe/near-total occlusion of the left cervical ICA. Significant collateral blood flow to the left MCA territory was seen coming from the right ICA via the anterior communicating artery, vertebro-basilar system via the left posterior communicating artery, and the leptomeningeal collaterals. Optimal medical management was done, using anti platelet, low molecular weight heparin, and statin, along with adequate blood pressure control and management of hyperglycemia. No mechanical revascularization procedure was done at this point.

After 2 days, patient was noted to be more drowsy, with a decrease in GCS by 3 points. Cranial CT scan showed evolution of the infarct, now involving the entire left ACA and MCA territory (Figure 4). Patient was given medical decompressants, and underwent left hemi-craniectomy. Subsequently, patient was noted to improve, seen conscious and follows verbal commands inconsistently, with an modified Rankin Scale of 4.

DISCUSSION

Current literature provides no clear answers on the management of acute occlusion of the proximal, extracranial ICA. Even though IV rt-PA has been established as the first line treatment for acute ischemic stroke, but the recanalization rate of the ICA still remains low (4). The recent endovascular therapy trials for acute stroke are mostly for intracranial occlusions, and patients with cervical ICA occlusions are either excluded or are not well represented. Also, no randomized controlled trial has compared endovascular treatment with medical therapy for these types of occlusions. However, several approaches have been described in different case series like intra-arterial thrombolysis, clot disruption, angioplasty, aspiration, stenting, and mechanical thrombectomy using stent retrievers in the cervical ICA4.The ICARO-3 (Intravenous Thrombolysis or Endo-vascular Therapy for Acute Ischemic Stroke Associated With Cervical Internal Carotid Artery Occlusion) study was a non randomized trial that showed endovascular treatment of acute cervical ICA occlusion did not result in a better functional outcome compared to those treated with IV rt-PA and optimal medical management. **(5)**

Treatment approaches for carotid artery disease depends on the degree of luminal stenosis and clinical symptoms. The relationship of collateral flow to these two variables has been the topic of several researches, implying that decision making for management may be refined with consideration of collaterals. It has been shown that presence of collaterals is associated with lower risk of hemispheric stroke and transient ischemic attack in patients with carotid stenosis(3). Preservation of flow through primary and leptomeningeal collaterals is known to reduce ischemic brain damage and produce better functional

recovery. This effect was seen in patients treated with IV rt-PA alone or with endovascular techniques **(6)**.

Because of these findings, it was hypothesized that augmentation of collaterals can increase the cerebral blood flow, and thus, decrease the extent of tissue damage during ischemia. However, approaches, both pharmacologic and interventional, have met limited success **(2)**. Several studies have investigated use of volume expanders and hemodilution (using dextran, starch, or albumin), vasodilation, and induced hypertension to increase collateral circulation after stroke. All of these did not show any significant difference in terms of functional improvement after stroke when compared to standard medical management.

Non - pharmacologic approaches include external counterpulsation (increasing diastolic pressure to decrease systolic afterload), partial occlusion of abdominal aorta using the NeuroFlo device, sphenopalatine ganglion stimulation to activate parasympathetic-induced vasodilation of cerebral vessels, and transcranial laser therapy. All these have not been shown to improve outcomes and have been limited to experiments and case series **(2)**.

Extracranial to intracranial carotid artery (EC-IC) bypass surgery with anastomosis of the superficial temporal artery branch to cortical branch of the middle cerebral artery was designed to augment flow to the anterior circulation in those with carotid occlusion. **(2)** The Carotid Occlusion Surgery Study (COSS)**(7)**showed no beneficial effects for the EC-IC bypass, even though patients under the treatment group had excellent bypass graft patency and improved cerebral hemodynamics**(2,8)**. Also, a higher perioperative stroke rate in the bypass arm was noted.

These findings lead us back to the use of IV rt-PA, statins and anti-platelets for these patients. However, as illustrated here, this strategy is not enough. The presence of a good collateral circulation is not sufficient to ensure better outcomes for patients. The incipient development of collateral circulation does not guarantee its persistence. Its endurance is affected by hemodynamic fluctuations **(3)**. Our case did not have blood pressure fluctuations and was stable hemodynamically throughout his stay.

Another plausible explanation of the failure of IV rT-PA and presence of good collateral flow is the possibility of distal fragmentation of the thrombus within the parent vessel **(3)**. A decrease in thrombus burden because of 'partial' thrombolysis may soften the plaque and cause distal embolization. The clot debris upstream may occlude the existing collateral flow, precluding their supposed benefit. This may probably be the reason why long term outcomes of IV rt-PA in cervical ICA occlusion is not as good as those intracranially. Further studies are needed to see if intravenous thrombolysis actually worsens outcomes in patients with good collateral flow. This subset of patients may do better with standard medical therapy alone or even mechanical thrombectomy, rather than intravenous thrombolysis alone.

It is highly probable that we still do not understand the changes in cerebral hemodynamics and collateral blood flow during acute ischemic stroke enough to be able to utilize it to achieve better outcomes. Continued efforts to find novel methods to stimulate the formation of collaterals, augment blood flow, and maintain its durability are definitely a must. These novel ideas may even be better than aggressive recanalization in this subset of patients.

CONCLUSION

The current management for acute ischemic stroke caused by stenosis or occlusion of the cervical ICA remains to be ill-defined. Vascular remodeling through the collateral circulation is the body's attempt to re-establish blood flow but is often inadequate. Its presence remains to be a good prognostic factor. However, augmenting collaterals by pharmacologic and non-pharmacologic means have not been shown to provide clinical benefit. The current standard of care using intravenous thrombolysis, antiplatelets, and statin are not enough to achieve good outcomes for this subset of patients with good collaterals. The utility of IV rt-PA or mechanical thrombectomy for patients with good collaterals need further research.

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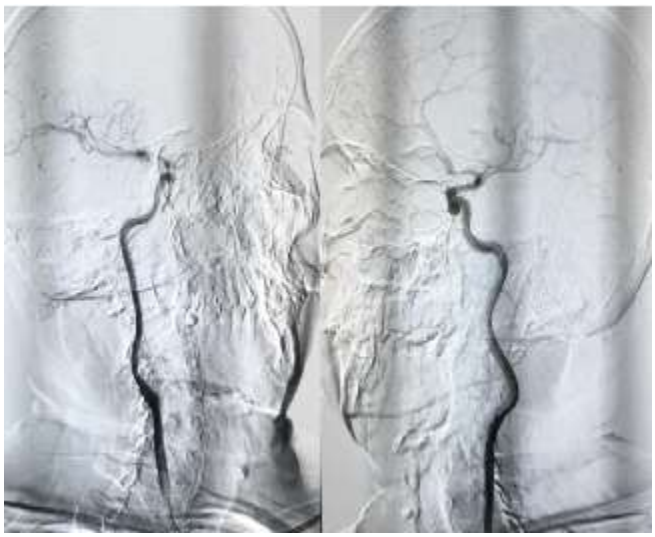

Figure 1.Initial DSA showing the right and left ICA.

Figure 2. Cranial MRI and MRA

Figure 3. Cerebral DSA showing (a) right CCA injection; (b,c) left CCA injection, (d) left subclavian injection).

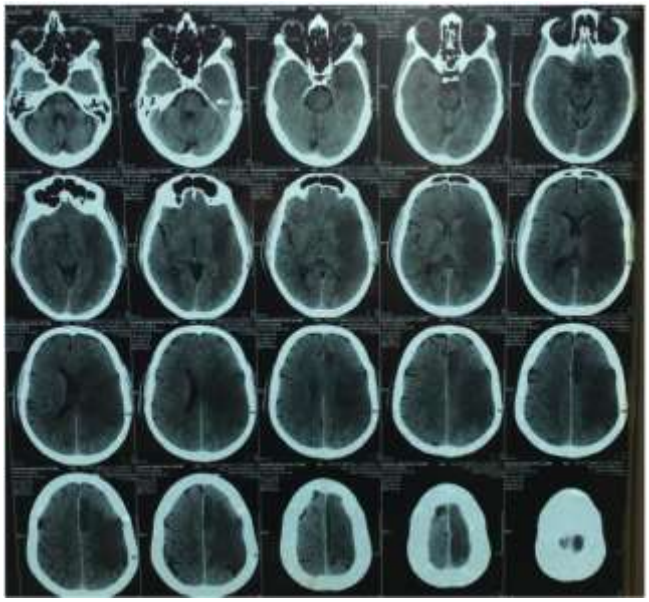

Figure 4. Cranial CT scan

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