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Editorial

The omentum in the surgical treatment of recurrent ischemic stroke

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The continuing prevalence of TIAs and strokes, the cerebrovascular conditions that are the result of cessation of blood flow to the brain, remain a medical problem in the United States. The American Heart Association stated that TIAs and strokes are the fifth leading cause of death in the United States. The blockage of blood flow in a TIA is temporary in terms of minutes to several hours without damage to the brain, whereas in a stroke blockage of blood to the brain results in permanent brain damage. The Center for Disease Control reported that of the 795,000 who experience a stroke each year, 200,000–500,000 also develop a TIA. It is significant that 25% (185,000) of the reported 795,000 stroke patients were the result of a recurrent stroke.

After a TIA, a stroke can occur due to the enlargement of the ischemic location of the TIA in the brain or by the development of new ischemic locations within the brain. A continuing decrease of cerebral blood flow (CBF) and a decrease in microcirculation in the brain resulting from a loss of cerebral capillaries due to the lower levels of vascular endothelial growth factor (VEGF) in the brain can lead to a recurrent stroke. This paper will report how an increase in CBF and cerebral microcirculation apparently can be achieved.

BLOOD FLOW

If decreased cerebral blood flow is the major factor in the development of a stroke, can the incidence of a recurrent stroke be decreased if CBF can be increased? When atheromatous plaque is found in carotid arteries, a carotid endarterectomy operation is performed in the attempt to increase CBF. Although the operation can be successful, it may not accomplish its goal. The widely accepted physical law that states fluids and blood will flow to areas of least resistance indicates that an increase in CBF following a carotid endarterectomy can increase blood flow more easily into non-ischemic areas of the brain. However, blood will flow less easily into ischemic areas in the brain where cerebral blood vessels are occluded and blood flow is deficient. What is needed is a large volume of blood to flow through extracerebral arteries into ischemic locations in the brain over an extended period of time. At present, no drugs or surgical procedure can accomplish this. However, placement of the omentum on the brain has been shown to deliver a large and continuing increase in CBF. This was observed in a study of stroke patients who showed a much higher continuing postoperative increase in CBF in comparison to preoperative CBF levels ($P > 0.0001$).[5]

CAPILLARY DENSITY

In addition to decreased CBF that can lead to a recurrent stroke is the loss of cerebral capillaries that are the basis for critical microcirculation in the brain. Microcirculation by way of capillary activity is responsible for the oxygen, glucose, and nutrient material that are necessary for brain viability. VEGF, the most angiogenic material in the body, is directly responsible for the angiogenic development and maintenance of the capillaries that control cerebral microcirculation.[1] When there is a decreased level of VEGF in the brain, capillary density decreases.[2] If the incidence of recurrent strokes is to be reduced, an increase in VEGF appears necessary to maintain capillary density in areas of critical cerebral ischemia.

The omentum

The omentum has been shown to increase CBF over an increasing period of time and it also has the potential to increase VEGF when an intact, vascularized omental pedicle is placed directly on the brain. The operation of placement of the omentum onto the brain has a long history, having shown initial success in the 1970s in dogs[6] and monkeys[7] in which the omentum, when placed on animal brains, prevented strokes in the presence of ligation of their middle cerebral artery. By the 1980s, the omentum had further been shown to restore neurological improvement when placed on brains of stroke patients.[9] After a half-century, omental transposition to the brain is now being accepted for conditions such as Alzheimer's disease,[8,10-13,15] Moya Moya disease,[3] malignant brain tumors,[14] and a host of neurological conditions.[17,18]

Based on the omentum's ability to deliver significant amounts of blood to the brain of stroke patients over an extended period of time, omental placement on the brain appears to have the potential to decrease the incidence of recurrent strokes.

Placement of the omentum directly on the brain can increase CBF, but it also has the potential to increase large amounts of VEGF to the brain. In rodents, VEGF was found to have 4–5 times the amount in the omental tissue as compared to any other location in the body.[20] One might expect that this high volume of VEGF found in rodents would also be present in human omentum.

VEGF's angiogenic activity stimulates the preponderance of capillaries in cerebral tissue, resulting in increased microcirculation in areas of cerebral ischemia. It seems reasonable to believe that an increase in CBF and an increase in amounts of VEGF in the omentum when introduced into the human brain could have the combined ability to reduce recurrent strokes. Even if a large amount of VEGF is present in human omental tissue; however, it will not have a clinical effect in the brain if the cerebral blood flow is not increased.[4] Furthermore, it has been shown that increased amount of VEGF does not increase CBF.[19]

DISCUSSION

Failure of drug therapy for a patient who has had a TIA followed by an initial and subsequent recurrent stroke is cause for concern. A patient will likely receive treatment of his TIA by anti-platelet drugs, such as aspirin and clopidogrel, both of which disaggregate accumulated platelets that are considered to be the source of the restricted blood flow within cerebral blood vessels. After the patient's first stroke following a TIA, anticoagulation drugs are likely to have been added to the previously prescribed antiplatelet drugs, especially in the presence of atrial `fibrillation. This drug therapy regimen has been found to fail one-quarter of patients who were treated for their initial TIA and subsequent stroke. Drug therapy did not increase CBF and microcirculation in the brain. A patient being offered drug treatments that had previously proven unsuccessful might readily accept a surgical procedure when informed of the omentum's ability to increase blood flow and capillary density in the brain.

The surgical procedure of placing the omentum on the brain to prevent recurrent strokes is currently being evaluated in several centers. One can ask if omental transposition to the brain for TIAs and strokes can be successful. A recent article evaluated information regarding TIAs and strokes compiled from fifteen separate papers published in international journals. Ninety-three patients were evaluated following placement of the omentum onto the brain for TIAs and strokes. The article concluded that omental transposition to the brain of TIA and stroke patients achieved cerebrovascular improvement:

> Surgical revascularization using omental tissue has shown good success rates, particularly for recurrent transient ischemic attacks and prevention of further strokes and should be considered as a treatment option for selected patients. Experimental data on the physiologic basis for postoperative improvement delivered convincing evidence for its arteriogenic potential, and developments in omental stem cell research suggest a role in recovery from longstanding neurological deficits.[16]

A controlled trial utilizing the omentum on patients with TIAs and strokes appears necessary and justified, especially in younger patients as one-third of all strokes occur in patients below the age of 65 years.

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