

OMENTAL TRANSPOSITION FOR CEREBRAL INFARCTION: A 13-YEAR FOLLOW-UP STUDY

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BACKGROUND

During the past decade there has been increasing use of omental transposition to the brain of patients who experienced neurologic sequelae after a cerebral infarction. This paper reports the long-term neurologic effects seen in a patient who underwent omental transposition 31 months after a stroke. Her postoperative follow-up period has been 13 years.

CASE DESCRIPTION

The patient had an expressive aphasia, a right hemiparesis and the inability to read which occurred immediately after her stroke. After surgery she demonstrated subjective and objective improvement in her speech and mobility. She also regained her ability to read shortly after surgery.

CONCLUSION

The patient demonstrated that omental transposition to the brain can improve neurologic function in the presence of a long-standing cerebral infarction and that the clinical improvement can be maintained over an extended period. © 1999 by Elsevier Science Inc.

KEY WORDS

Omental transposition, cerebral infarction, cerebral blood flow

During the past decade there has been increasing use of the omentum in treating a variety of conditions related to the central nervous system [1]. One of the more common indications for omental transposition to the brain has been in patients who had previously sustained a cerebral infarction. The purpose of this paper is to report the neurologic findings of a patient who had undergone the operation 13 years earlier.

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HISTORY AND PREOPERATIVE EVALUATION

The patient when seen was a 62-year-old white hypertensive Catholic nun who had a left middle cerebral artery occlusion 31 months earlier that resulted in an expressive aphasia, a marked right sided weakness, and the inability to read (alexia).

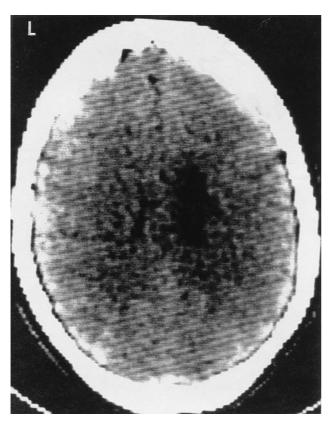
Examination showed the patient to have a severe non-fluent aphasia with dysarthria and slurring of her speech, which increased with fatigue. She had limited movement of her right wrist, right ankle and right leg, and walked with a spastic right hemiparetic gait that required a cane. Her blood pressure was 150/75; cranial nerves were normal except for a right central facial weakness. She had a Babinski response on the right and no sensory loss. Electroencephalographic (EEG) readings showed mild intermittent left temporal slow waves and asymmetry of her posterior rhythms with slower frequencies on the left than on the right. These findings were suggestive of persistent cerebral abnormality in the left cerebral hemisphere that were consistent with the patient's diagnosis of a middle cerebral artery territory infarction. No epileptic discharges were present.

Computed tomographic (CT) studies of the patient's brain taken at the time of her cerebral infarction showed an area of low density in the left basal ganglia with edema and a decrease in the size of the left lateral ventricle (Figure 1). In an attempt to lessen her neurological disabilities, the patient underwent omental transposition to the left cerebral hemisphere on August 8, 1984, 2 ½ years after her stroke.

OPERATIVE PROCEDURE

The surgical technique for omental transposition to the brain has been previously described [2]. The

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CT scan of the brain at time of stroke shows decreased density in the left hemisphere with reduction of the left lateral ventricle.

first step in the operation is to separate the omentum from the transverse colon. After this, the omentum is removed from its proximal and central attachments to the stomach, which is done directly on the gastric wall, preserving the gastroepiploic vessels within the omental apron. The left gastroepiploic artery and vein are then divided, causing the blood flow in the omentum to be supplied entirely from the right gastroepiploic vessels. To gain further omental length so that it can reach the brain without difficulty, the omentum is partially divided, with careful attention paid to preserving at least one major artery and vein that are maintained primarily along the omental periphery. After the omentum has been sufficiently lengthened to allow it to reach the brain without tension, incisions are made along the chest and anterolateral neck, which are connected by a long subcutaneous tunnel in which the omentum is placed.

A craniotomy is performed on the side of the brain on which the omentum is to be placed. The dura overlying the cerebral hemisphere is removed. The subcutaneous tunnel coming from the neck is extended behind the ear and beneath the scalp flap created for the craniotomy. Multiple openings are made in the arachnoid overlying the cerebral hemisphere followed by the omentum being laid directly upon the brain. The bone flap is returned to its normal position and all skin incisions are closed in a routine manner.

EARLY NEUROLOGIC COURSE

The patient had decreased spasticity and increased strength in her right arm by the third postoperative day. On this date it was reported that the patient had "definite improvement in speed of speech and language" as documented by neurological examination. She also felt that her speech was less "mushy." On the sixth postoperative day she suddenly became totally aphasic for 3 hours, at the end of which time speech abruptly returned. On the following day she again developed instantaneous and complete aphasia. This condition lasted for 6 days, at the end of which time her speech again suddenly returned. During this 6-day aphasic period, the patient could communicate by singing the words she wished to express. The temporary loss of speech the patient sustained was thought to be secondary to an intracerebral steal phenomenon, based on an earlier patient who had almost identical symptoms of abrupt onset but temporary aphasia. The possibility that this could occur was explained to the nun so that when it did occur, she and her family were not alarmed and were not surprised when she recovered spontaneously. At the same time that her speech returned, there was dramatic improvement in her walking.

NEUROIMAGING STUDIES

A CT scan of the patient's brain at the time of her infarction showed a compressed lateral ventricle in the left cerebral hemisphere with an area of decreased density in the cortex and white matter (Figure 1). When the patient became aphasic shortly after surgery, a repeat CT scan showed the omentum to be intact over the area of the cerebral infarction without any pressure on the underlying brain (Figure 2). The left lateral ventricle was enlarged as a result of the loss of cerebral tissue following the infarction. A magnetic resonance image (MRI) done 11 years after omental transposition showed that the omentum had almost disappeared on radiological examination, which indicated the adaptation over time of the soft tissue that had been placed within the cranial vault many years earlier (Figure 3).



2 CT scan of the brain at time of aphasia 3 days after omental transposition. Note decreased density in middle cerebral artery territory and enlargement of left lateral ventricle from loss of brain parenchyma. Omentum seen as black area under craniotomy site with no pressure effect on brain.

LATE POSTOPERATIVE FOLLOW-UP STUDIES

During the 13 years since surgery, the patient's speech has remained markedly improved with only minimal dysarthria, which becomes apparent when she is overly tired. Her gait remains good and she no longer needs a cane to walk, which she required before surgery. From the time of her stroke to surgery (31 months), the patient had been unable to read. By 6 weeks after surgery, however, she spontaneously began to read again. She now reads at what she considers her pre-stroke level. One has difficulty in even suspecting when she speaks over the telephone that she ever sustained a stroke.

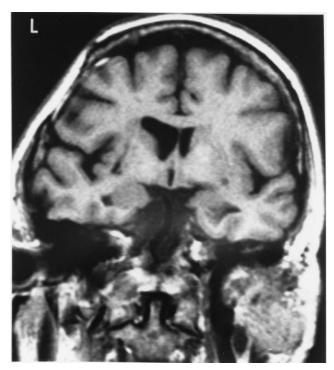
NEUROPSYCHOLOGICAL EVALUATION

The patient states there has been no decline in her cognitive processes since surgery with some mental skills, such as reading comprehension and concentration, having actually improved. Outside of

deterioration in her speech when fatigued, she claims no other negative findings. Her intelligence quotient (IO) before surgery was reported as being high average range (113). Eleven years after her operation at age 73, another IQ test was reported as; "overall IQ at this testing is in the superior range with verbal IQ in the superior range and performance IQ in the high average range." Her estimated native cognitive abilities were also reported to be in the superior range based on performance tests of academic information, comprehension, and similarities. Further psychological testing reported, "the patient continues to perform at average levels on tests of attention, sequencing, visual organization, and word list generation compared to above average abilities in other cognitive domains. She did show slight decline in simple attention such as naming word list generation. Despite her occasional lapses on attention tests, she performed at superior levels on tests of memory and well retained that which she had learned. The patient continues to maintain her current living demands 13 years after surgery, which include daily activities, finances, and driving."

DISCUSSION

It was first shown in 1973 that placing the omentum on the brain of a dog could result in the rapid



3 MRI of brain 11 years after surgery. Loss of tissue density and enlarged left ventricle persists. No definite omental tissue remains beneath craniotomy site.

development of vascular connections through the omentum-cerebral interface [3]. Subsequent studies showed that the omentum could supply sufficient blood to the dog [4] and the monkey brain [5] to prevent a cerebral infarction even in the presence of middle cerebral artery ligation. Eventually, omental transposition to the human brain was performed in patients who were suffering the sequelae of a cerebral infarction [6]. There are now continuing reports of the effectiveness of the omentum in treating cerebral infarctions and/or TIAs as well as an increasing variety of additional neurological conditions [1].

When omental transposition was first performed on the brain of a patient who had previously suffered a stroke, it was never expected that the operation would have an effect on already infarcted cerebral tissue. What was believed, however, was that additional blood flow to the brain supplied by the omentum might have beneficial effects on penumbral cells surrounding the infarction site, cells that were still viable but with decreased neuronal activity because of marginal blood supply. When omental transposition to the brain was first reported in stroke patients, it was initially assumed that the neurological improvement resulted from increased CBF supplied by the omentum. But the later discovery of neurotransmitters [8], and omental-derived nerve growth substances [10] in omental tissue then raised the possibility that these biological agents might also have played a significant role in the subsequent neurologic improvement. Since that time, additional growth factors have been identified in omental tissue [11,12]. At the present time it remains unknown as to how the omentum affects brain function.

This report suggests that postoperative neurologic improvement after omental transposition to the brain does not diminish over time. A logical criticism of this suggestion is that no proof has been shown that the transposed omentum in the patient being presented had increased CBF or metabolism in the underlying area of her brain, or that the patient's recovery was anything other than the recovery that would have occurred without operation. I believe this criticism can be countered by the fact that many investigators are seeing neurologic improvement very shortly after OT to the brain in patients with a cerebral infarction of long duration [1]. Additionally it has been shown that the omentum adds a significant and increasing volume of blood to the brain in humans [7]. Also of significance in a cause-effect relationship to explain the neurologic improvement after OT in this preoperatively alexic patient is that she regained her ability

to read just weeks after surgery. This newfound ability to read years after a stroke and within days to weeks after OT has been seen in 9 of 11 alexic patients in a personal series (HSG). It seems reasonable to assume that there is a causal relationship between OT to the brain and improved neurologic function.

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COMMENTARY

The subject of brain revascularization provokes controversy and emotion as few others in the neurosciences do. The major problem with studies involving cerebral ischemia is that neither neurosurgeons nor (in particular) neurologists have studied the natural history of the disease in a population of patients with angiographically demonstrated lesions. Some of this work has been attempted in the recent randomized studies of carotid endarterectomy and EC-IC bypass. However, these studies mainly used carotid angiography; they did not include four-vessel angiography. Carotid angiography alone is not sufficient for an understanding of the collateral circulation to the brain. Perhaps with the development of MR angiography, this problem can be overcome and the appropriate studies can be done noninvasively.

One of the major criticisms of any reported observation of a dramatic improvement after treatment of cerebral ischemia is that the improvement can be attributed to the natural history of the disease, which is largely unknown. Statements such as "This improvement could have happened even without the treatment" are commonly heard in reference to observations of spectacular improvement of patients in case or series reports. This criticismattributing improvement to natural history-seems to be accepted by the scientific community as valid, even though there is virtually no documentation of the natural history of cerebral ischemia. In truth, the conclusion that the improvement is attributable to the natural history of the disease has no more validity than the argument that the observation of improvement, based on a single case, is real.

The second criticism usually voiced is that a randomized study is necessary to determine the reason for the spectacular recoveries cited in case reports. Although this may be true, the neurologic and neurosurgical investigations of cerebral ischemia over the past 50 years have failed to provide adequate or appropriate studies to determine the natural history of cerebrovascular disease. Furthermore, the randomized studies that have been done are inadequate to answer the questions regarding the natural history, particularly in view of the fact that only a portion of the circulation has been visualized angiographically. Randomized studies are limited by their design and by the knowledge available at the time the study is done. mised, his critics say, by the fact that he is a general surgeon working in the area of neurosurgery, and that he lacks the credentials to have his work accepted in this field.

I believe that these criticisms of Dr. Goldsmith's study (and other similar studies) are unfair. By itself, this case report represents a unique observation which does have some scientific basis, as indicated in the discussion. Similar observations have been made by many investigators performing bypass surgery. For example, when a patient has developed a natural extracranial-to-intracranial collateral circulation through the ophthalmic artery or other vessels to supply the cerebral circulation, neurologists and neurosurgeons viewing the films readily admit that it is this collateral circulation that has saved the patient from an ischemic event. Yet, the idea of performing a revascularization procedure to achieve the same result is immediately criticized and discarded. These positions are contradictory and make no sense.

There are clear scientific implications of Dr. Goldsmith's observations; our own scientific inadequacy is the cause of our inability to explain them. Rather than discard these observations for any of the reasons given, it would behoove both neurologists and neurosurgeons to question why these improvements occur. This type of query may lead to a greater understanding of cerebral ischemia and a revelation of processes that have, up to now, been hidden by the unscientific rejection of such observations.

Dr. Goldsmith's article is provocative and challenging, and his results demand explanation. Perhaps more scientists will begin to study the phenomenon that Dr. Goldsmith has observed and design appropriate studies to either validate or reject it.

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This work by Dr. Goldsmith is further compro-

A t present there is a terrific imbalance between individual decision making as expressed in markets and collective decision making as expressed in politics. We have a global economy without a global society. This situation is untenable. ... To stabilize and regulate a truly global economy, we need some global system of political decision making. In short, we need a global society to support our global economy.

> -GEORGE SOROS "THE CRISIS OF GLOBAL CAPITALISM" (1998)