Summary of the Third International Symposium on Microneurosurgical Anastomoses for Cerebral Ischemia

June 28-30, 1976, Rottach-Egern, West Germany

Prepared by Robert Spetzler, M.D.,1 Peter Schmiedek, M.D.,2 and Otmar Gratzl, M.D.3

Honorary Chairman, Professor Hugo Krayenbuhl,* Organizing Committee, Otmar Gratzl, M.D., Peter Schmiedek, M.D., and Robert Spetzler, M.D.

Professor H. Krayenbuhl (Zurich, Switzerland) reminded the meeting that the concept of revascularization began in 1950 when Dr. Henschken, Professor of Surgery at the University of Basel, transplanted a pedicle of temporalis muscle to the cerebral cortex of an epileptic patient who had bilateral carotid stenosis. Postoperatively the seizures stopped but angiographic verification of graft function was not possible. He reviewed the history of the extracranial-intracranial arterial bypass (EIAB) starting with Yasargil's experience in Donaghy's laboratory where the feasibility of this anastomosis was demonstrated in dogs and their first EIAB performed in humans late in 1967. Yasargil's second patient, operated on in 1967 for left-sided hemiparesis and homonymous hemianopia, showed angiographic proof of shunt patency and dilatation of the temporal artery 7½ years following surgery.

Hossmann (Cologne, W. Germany) discussed "Experimental Ischemia of the Brain," reporting his observations of animals with intrathoracal ligation of the innominate and subclavian arteries and induced hypotension and occlusion of the mammary arteries. This technique allowed complete and reversible interruption of total blood flow to the brain while maintaining normal circulation to other organs of the body. Interruption of cerebral blood flow caused almost immediate loss of consciousness, flattening of the EEG after 12-15 seconds, suppression of synaptic excitability of the neurons after 2-4 minutes and suppression of electrical excitability after 6-8 minutes. Brain function can return even after one hour of ischemia.

Heiss (Vienna, Austria) presented his studies of cerebral ischemia produced by a suture around the middle cerebral artery through an approach via the orbit. On occlusion of the vessel, abrupt changes of H2 clearance occurred in the brain. Abrupt changes of the EEG after 12-15 seconds, suppression of synaptic excitability of the neurons after 2-4 minutes and suppression of electrical excitability after 6-8 minutes. Brain function may return even after one hour of ischemia.

Fein (Bronx, New York) recorded regional oxygen extraction rates and blood flow by a polarographic technique in an animal model in which ischemia was produced by occlusion of the middle cerebral artery. He found an immediate area of ischemia distal to the occlusion which was surrounded by hyperemic zones with either normal or increased oxygen extraction rates. When an EIAB was performed prior to the ischemic insult there was no discernible effect on the oxygen extraction rate distal to the occlusion.

Schmiedek (Munich, W. Germany) described 55 patients evaluated by computerized tomography as well as regional cerebral blood flow and found good correlation in nine patients presenting with completed stroke.

Chater (San Francisco, California) reported on a series of 140 cases of EIAB followed 3 to 36 months. A patency rate of 95% was achieved. Operative mortality was 2%, while permanent operative morbidity was 1.7%. The incidence of late stroke was less than 5% and all but one occurred in the untreated hemisphere.
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Mizukami (Gunma, Japan) analyzed 40 patients with an EIAB who had presented initially with complete stroke (36) or a slowly progressive stroke (4). He found that patients with a severe neurologic deficit from onset did not improve substantially from the EIAB. But patients with a mild or moderate neurologic deficit, particularly if onset was slow, showed good results from bypass surgery. He emphasized the need for measuring cortical arterial pressure and reported that patients with a pressure of 40 mm Hg or higher fared better than patients in whom the pressure was less than 40 mm Hg.

Fein (Bronx, N.Y.) reported on reversal of nutrient steal effects by STA-MCA microanastomosis. He noted two cases with a major vessel occlusion in which a steal phenomenon from normal tissue to the ischemic tissue was postulated as a cause of symptoms. In one patient with a middle cerebral artery occlusion, transient episodes of hemiparesis occurred as well as a significant homonymous hemianopia. An EIAB eliminated the transient ischemic attacks and significantly improved the homonymous hemianopia. In a second patient poor vision was recorded, presumably secondary to a retinal-ophthalmic to middle cerebral arterial steal. The patient's vision improved following EIAB surgery.

Weinstein (San Francisco, California) reported six patients who had EIAB after being diagnosed as having a stroke-in-evolution. Despite a significant preoperative neurologic deficit and a positive brain scan in three patients, no deterioration due to hemorrhagic infarction occurred following surgery.

Merei (Pecs, Hungary) reviewed the results of 90 anastomoses performed over a three-year period with a postoperative patency rate of 83.3% at two weeks. Late angiography at 1–3 years following operation revealed that some early bypass occlusions were now open.

Piepergus (Rochester, Minnesota) reported on six cases of occipital artery to posterior inferior cerebellar artery anastomosis for the treatment of vertebrobasilar insufficiency with 100% patency and resolution of episodic ischemic events postoperatively in all patients. Complications included severe pneumonia, increased cerebellar deficit, and postoperative obtundation. There were no deaths.

Khodadd (Cincinnati, Ohio) reported that patients with basilar artery insufficiency may be improved by anastomosis of the occipital artery to the posterior inferior cerebellar artery. He described two patients in whom such an operation was performed and who showed neurologic improvement following surgery.

Herrschaft (Cologne, W. Germany) followed 25 patients with stenotic lesions of the middle cerebral artery who had an acute ischemic event. He performed serial regional cerebral blood flow studies from one day to six months. In all 25 patients he found an ischemic focus or an ischemic focus with simultaneous reduction of the global blood flow. Except for a slight increase in the global flow no significant flow change occurred in the ischemic foci over a six-month followup period.

Reichman (Chicago, Illinois) reviewed his indications, complications, and results in 85 patients with STA-MCA anastomosis. He was encouraged by the results but stressed the need for a randomized trial of operative and nonoperative treatment of patients with cerebrovascular ischemia.

Kikuchi (Osaka, Japan) reported on ten patients with Moyamoya syndrome treated with EIAB surgery. He stated that obliteration of the basal arteries is often progressive. Nine of ten patients improved clinically after surgery but because of the brief followup (14 months) no prophylactic effect could be proved.

Hapman (Munich, W. Germany) reported on fifty patients with an EIAB in whom a Duplex study was performed and who then underwent angiography. He found a high correlation (48/50) of positive results with no false negatives.

Dujovny (Pittsburgh, Pennsylvania) reported on a series of dogs in which the middle cerebral artery was embolized with a pliable cylinder. A microsurgical embolectomy was performed six hours following embolization. The animals were then divided into three groups for postischemic treatment: a control group, a steroid-treated group and a dimethyl sulfoxide (DMSO) group. The author found that half the control animals died within 48 hours postoperatively from hemorrhagic infarction; the remainder sustained a severe neurologic deficit. All animals treated with methylprednisolone died within ten days. All animals treated with DMSO, however, remained alive and without neurologic deficit.

Weinstein showed multiple scanning electron micrographs of an anastomosis following various microsurgical manipulations. He demonstrated the considerable endothelial disruption that may occur during microvascular surgery. Endothelial damage at suture sites was reduced after using gentler techniques and finer sutures.

Ito (Tokyo, Japan) presented results of a complex study on cerebral changes during recirculation after temporary ischemic insults in Mongolian gerbils. The author recorded histopathologic, electroencephalographic, blood-brain-barrier breakdown. Electron microscopic studies using horseradish peroxidase revealed increased pinocytotic activity in the endothelial cells of the ischemic cerebral vessels. Blood pressure increase following ischemia apparently furthered blood-brain-barrier breakdown.

Meyermann (Goettingen, W. Germany) reported that histological examination of anastomosis performed on rat carotid arteries revealed a repair process similar to that occurring after vascular surgery elsewhere in the body.

Conforti (Naples, Italy) reviewed the response of rabbit cortical microvasculature to focal cerebral ischemia produced by transorbital occlusion of the middle cerebral artery. The authors observed collateral circulation forming with the passage of time between the ischemic middle cerebral artery network and the anterior and posterior cerebral arteries.

Kletter (Vienna, Austria) compared 30 conventionally sutured rat carotid anastomoses with 50 clot-sutured anastomoses. In the latter group he placed two stay sutures 180° apart to approximate the vessel edges, and for the anastomosis used a fibrin suspension to which calcium was added at the time of application. Clotting took approximately two seconds. Results were examined
patients then had EIAB with further improvement of their some neurological and EEG improvement. Eleven of these acute event and were submitted to hyperbaric oxygen occlusion who had a fixed deficit four weeks following the cerebral infarction secondary to internal carotid artery tomography.

completed stroke showed any improvement and two bypasses verified 100% patency. Of 11 patients presenting with STA diameter in patients with stenotic lesions.

PRINDs preoperatively, nine were asymptomatic and two died. Only one patient, who had some improvement of normal rCBF. The three patients with completed strokes all presented with TIAs and PRINDs preoperatively had a after an EIAB. He found that seven patients who had occlusion, as opposed to little change in the postoperative occurred frequently in patients with intracranial vessel occlusion, as opposed to little change in the postoperative STA diameter in patients with stenotic lesions.

Crowell (Boston, Massachusetts) reviewed some experimental and clinical data suggesting that acute reperfusion of an ischemic cortical lesion can prevent irreversible infarction. He summarized the results of ten patients operated on by six different surgeons for emergency EIAB for acute ischemia. Two cases showed early improvement, probably related to surgery; four showed gradual improvement, and four died.

Otteau-Nerbe (Munich, W. Germany) reported angiographic and rCBF findings in ten patients 2.5–4.5 years after an EIAB. He found that seven patients who had presented with TIAs and PRINDs preoperatively had a well-functioning anastomosis, no neurologic deficits, and normal rCBF. The three patients with completed strokes all had a patent bypass, although in one the anastomosis caliber was poor. Only one patient, who had some improvement of rCBF, improved clinically.

Chater presented surgical results in patients with severe dementia from multiple vessel occlusion. This rare form of dementia appeared to respond favorably to reperfusion of tiate patients with partially reversible deficits from those with irreversible neurological deficits.

Heilbrun (Salt Lake City, Utah) reported on 28 patients with various vascular occlusive lesions who had ischemic symptoms and abnormal rCBF results. The patients were treated with either surgery or anticoagulation or were not treated. No difference among the three groups appeared during followup. Since the numbers were small and the treatment selection not random, it was difficult to assess the effect of any specific treatment.

Ito and his group studied 19 patients with middle cerebral artery trunk occlusion with rCBF and somatosensory evoked potentials (SEP) during normal and increased blood pressure preoperatively and postoperatively. They performed fluorescein angiography, measured STA and MCA stump pressures, and blood flow through the EIAB, and conducted rCBF studies during the operation. They developed certain criteria for selecting patients for an EIAB. A favorable outcome was more likely if 1) rCBF is in the 25 to 32 ml/100g/min range without global loss of autoregulation or loss of CO2 response; 2) the amplitude of the SEP is augmented with induced hypertension; 3) STA-MCA shunt flow is within 40–90 ml/min and MCA flow is from 40–60 mm Hg; and 4) the lenticulostriate arteries show normal filling on angiography and retention time of contrast media in the ischemic zone is between 4.5 and 7 seconds.

Merei used intraoperative 1% Fluorescine injection to identify the ischemic focus. He stated that even small areas of ischemia are easily demonstrated and he used this technique to determine the site for the EIAB.

Ausman (Minneapolis, Minnesota) reported on 22 patients with EIABs in whom the initial 5–21-day postoperative angiogram revealed 80% patency and followup angiography revealed 90% patency. He found good correlation between degree of angiographic filling of the ischemic hemisphere through the EIAB and the clinical results.

Deruty (Lyon, France) reviewed 23 patients who had EIAB. He said that postoperative enlargement of the STA occurred frequently in patients with intracranial vessel occlusion, as opposed to little change in the postoperative STA diameter in patients with stenotic lesions.

Stoke (San Francisco, California) found that patients with TIAs did not reveal any changes on computerized tomography.

Hohlbach (Bonn, W. Germany) reported on 20 patients with cerebral infarction secondary to internal carotid artery occlusion who had a fixed deficit four weeks following the acute event and were submitted to hyperbaric oxygen chamber treatments. Eleven of 20 patients demonstrated some neurological and EEG improvement. Eleven of these patients then had EIAB with further improvement of their neurologic status. The author said that hyperbaric oxygen treatment of patients with completed strokes can differen-
the ischemic hemispheres.

Kletter found that although atherosclerosis did occur in the STA, there was an increase of elastic fibers in the STA wall with aging (as opposed to other vessels) enabling it to dilate despite atherosclerosis. Kletter also reported failure to create a patent vascular anastomosis to a vessel on an ischemic spinal cord. He did show, in contrast, that pedicled muscle grafting can vascularize the spinal cord.

Collice (Milan, Italy) described a rat carotid artery model for surgeons seeking facility in microvascular technique.

Participants

The following were among those who presented papers at the Third International Symposium:

Dr. M. Hossmann, Max-Planck-Institute, Cologne, West Germany; Dr. W. Heiz, Klinik und Poliklinik fur Neurologie, Universitat, Bonn, West Germany; Dr. J. Astrup, Dept. of Clinical Physiology, Bispebjerg Hospital, Copenhagen, Denmark; Dr. G. Austin, Loma Linda U. Medical School, California; Dr. J. Feis, Dept. of Neurological Surgery, Albert Einstein College of Medicine, Bronx, N.Y.; Dr. Norman Chater, Dept. of Neurological Surgery, Davies Medical Center, U. of California, San Francisco; Dr. M. Mizukami, Inst. of Brain and Blood Vessels, Mikano Memorial Hospital, Gunma, Japan; Dr. P. Weinstein, Dept. of Neurological Surgery, U. of California, San Francisco.

Also Dr. F. Moret, Dept. of Neurological Surgery, U. of Pecs, Pecs, Hungary; Dr. D. Pieprz, Dept. of Neurological Surgery, Mayo Clinic, Rochester, Minnesota; Dr. G. Khodadad, U. of Cincinnati Medical School, Ohio; Dr. H. Herrschall, Neurolog. Klinik and Max-Planck-Institute; Dr. O. Reichman, Div. of Neurological Surgery, Loyola U., Chicago, Ill.; Dr. H. Kikuchi, Dept. of Neurological Surgery, Kitano Hospital, Osaka, Japan; Dr. H. Happan, Dept. of Neurology, Munich U., W. Germany; Dr. M. Dujovny, Dept. of Neurology, U. of Pittsburgh, Pa.

Also Dr. U. Ito, Dept. of Neurological Surgery, Tokyo Medical U., Tokyo, Japan; Dr. R. Meyermann, Dept. of Neuropathology, Nervenklinik, Goettingen, W. Germany; Dr. P. Conforti, Inst. di Neurochirurgia, Napoli, Italy; Dr. G. Kletter, Neurochirurg. U. Klinik, Vienna, Austria; Dr. G. Allen, Dept. of Neurosurgery, The Johns Hopkins U., Baltimore, Md.; Dr. C. Bannister, Dept. of Neurological Surgery, North Manchester General Hospital, Manchester, England; Dr. L. Auer, Neurochirurg. U. Klinik, Graz, Austria; Dr. K. Holbach, Neurochirurg. U. Klinik, Bonn, W. Germany; Dr. M. Heilbrun, Div. of Neurological Surgery, Utah U., Salt Lake City.

Also Dr. J. Amsden, Dept. of Neurological Surgery, University of Minnesota; Dr. D. Deny, Hôpital Neurologique, Lyon, France; Dr. R. Crowell, Dept. of Neurological Surgery, Harvard Medical School, Boston, Mass.; Dr. V. Oltmann-Nerbe, Neurochirurgia U. Klinik, Munich, W. Germany; Dr. M. Collice, Ospedale Maggiore, Milano, Italy.

Summary of Eighth International Salzburg Conference on Cerebral Vascular Disease,

Salzburg, Austria, September 22-25, 1976

PREPARED BY JOHN STIRLING MEYER, M.D.

Chairman of the Conference: David H. Ingvar, M.D.1
Organizing Secretaries: O. Eichhorn, M.D.,2 H. Lechner, M.D.3
Advisory Board: C. Fazio, M.D.,4 D. H. Ingvar, M.D.,1
J. Marshall, M.D.,4 J. S. Meyer, M.D.,4 and K. J. Zulch, M.D.3

DR. P. O. YATES (Manchester, England) reported on quantitative neuronal measurement profiles in senile dementia and advised caution in correlating regional blood flow changes and dementia. Regional blood flow may be normal despite abnormal brain function and vice versa. He stressed the importance of the strategic localization of cerebral infarctions necessary to produce dementia. With new biochemical methods for identification of ribonucleoproteins, cytophotometric analysis permits quantitative estimation of nuclear and nucleolar volume in diseased brains. In senile dementia 17% to 50% of the Nissl material is lost in a diffuse manner, although some neurons may remain normal, particularly in the thalamic, locus ceruleus and some granial nerve nuclei. There is a similar loss of Nissl material with age but those patients with clinical signs of dementia showed much greater changes.

Dr. L. Gustafson (Lund, Sweden) presented a series of 17 patients with the clinical diagnosis of "presenile dementia" studied during life with regional cerebral blood flow (rCBF). Diagnosis at autopsy was Alzheimer's disease in five, Pick's type of frontotemporal degeneration in four, multi-infarct dementia in four, Jakob-Creutzfeldt disease in three and postencephalitic dementia in one. There was significant correlation of the reduction of flow of fast and slow compartmental values with atrophy of gray and white matter. There was good regional anatomical correlation of pathological changes with flow values but poor correlation for the medial aspects of the hemispheres.

Dr. F. L. Perez (Houston, Texas) reported on statistical correlation of psychometric tests with reduced rCBF in a series of patients with Alzheimer's disease (AD) and multi-infarct dementia (MID). In AD frontal, temporal and parietal reductions of flow were marked while in MID the temporal and parietal zones in the middle cerebral artery territory tended to be more reduced. In AD both performance and memory IQ were significantly reduced whereas in...
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