Abstracts

AB-2316-76
Ophthalmic Arterial Blood Pressures Measured by Ocular Plethysmodynamography — Sand BJ (3838 Wilshire Boulevard, Beverly Hills, California 90211), Barker WF, Freeman LW, Hummell S — Arch Surg 110:813-818 (July) 1975*

The indirect measurement of ophthalmic arterial blood pressure is an important index in the understanding of cerebral vascular hemodynamics. Ophthalmodynamometry (ODM), the prototype for such measurement, is, however, replete with difficulties that have limited its widespread use.

A preliminary evaluation of a new technique for ODM, identified as oculcar plethysmodynamography, has yielded accurate ophthalmic blood pressure data without the attendant problems. Reproducible values for bilateral ophthalmic arterial pressure levels have been determined in 30 normal volunteers and the levels correlated to brachial arterial pressure levels.

In a series of patients with arteriographically demonstrable carotid obstructive lesions, the preoperative ophthalmic arterial pressure levels have been determined in 30 patients admitted during a three-year period. In 28, the aneurysms were treated by direct surgery with no deaths; 26 of these were admitted during a three-year period. In 28, the aneurysms of the anterior communicating artery who were

AB-2317-76
Experimental Cervical Myelopathy. Effects of Ischemia and Compression of the Canine Cervical Spinal Cord — Gooding MR, Wilson CB (Department of Neurological Surgery, University of California School of Medicine, San Francisco, California 94143), Hoff JT — J Neurosurg 43:9-17 (July) 1975*

The authors report experiments designed to test the effect of regional ischemia induced by selective vascular ligations and anterior compression of the cervical cord at two adjacent segments (C-4, C-5) in the same dog. They conclude that local ischemia of the cervical cord, caused by local deformation, when superimposed on a regional reduction in spinal cord blood flow, accounts for the myelopathy of cervical spondylosis whether produced experimentally in animals or occurring naturally in man.

AB-2318-76

Computed tomography (CT) of the head is a highly accurate new radiological technique for the evaluation of neurological disease. Analysis of early cases indicates that

*Authors' abstract.

These abstracts were assembled for publication by the Neurological Information Network of the National Institute of Neurological and Communicative Disorders and Stroke through Contract Number NS6-0933 with Dr. Robert G. Sirkert, Head, Abstract Section, Mayo Clinic, Rochester, Minnesota 55901.

the appearance produced by CT in some conditions is unique and that increasing experience allows the neuroradiologist to predict the position and nature of disease processes with greater accuracy.

AB-2319-76
Intracellular Enzyme Liberation in Primate Spinal Cord Injury — Yashon D (Division of Neurological Surgery, Ohio State University College of Medicine, Columbus, Ohio 43210), Bingham WG Jr, Friedman SJ, Faddoul EM — Surg Neurol 4:43-51 (July) 1975*

Intracellular lysosomal and nonlysosomal enzymes, as well as tissue edema, were measured in spinal cords of monkeys up to 20 days following a 300 gm-cm open injury. Although edema was maximal between six hours and 11 days, enzyme elevation was delayed. Lysosomal enzyme acid cathepsin increased beginning at five days and the β-glucuronidase and β-glycerophosphatase increase began at 11 days. Nonlysosomal enzymes were either not elevated or showed a slight rise. These data suggest that edema, one of the secondary damaging factors in spinal injury, is not a result of release of these intracellular enzymes. Also it appears that intracellular enzymes do not participate in early secondary damaging processes in severe spinal injury.

AB-2320-76
Relative Efficacy of Radionuclide Imaging and Computed Tomography of the Brain — Pendergrass HP (Department of Radiology, Massachusetts General Hospital, Boston, Massachusetts 02214), McKusick KA, New PFJ, Potsaid MS — Radiology 116:363-366 (Aug) 1975*

Computed tomography (CT) with the EMI scanner has been demonstrated to possess a wide spectrum of capabilities in the diagnosis of suspected intracranial disease. This review of 418 dual CT and radionuclide (RN) brain images indicates that RN and CT are complementary in the diagnosis of cerebral infarction, but that CT has a greater capability in brain tumor detection. The classical RN static brain image does not detect cerebral atrophy, hydrocephalus or intraventricular hemorrhage; these conditions are clearly defined by CT.

AB-2321-76
Quality of Survival Following Direct Surgery for Anterior Communicating Artery Aneurysms — Sengupta RP (Department of Neurosurgery, Newcastle General Hospital, Newcastle upon Tyne, England), Chiu JSP, Brierley H — J Neurosurg 43:58-64 (July) 1975*

The authors describe a series of 32 patients with ruptured aneurysms of the anterior communicating artery who were admitted during a three-year period. In 28, the aneurysms were treated by direct surgery with no deaths; 26 of these patients were studied psychometrically from four to 33 months after operation. There was no evidence of post-
operative intellectual impairment; however, there were personality changes associated with loss of interest, initiative, and energy. Analysis of the different factors involved suggests to the authors that the outcome of surgery depends mainly on preoperative clinical condition which, in turn, reflects the severity of the hemorrhage.

**AB-2322-76**

Morbidity and Mortality in Pseudopolythemia — Burge PS, Johnson WS, Prankerd TAJ (Department of Clinical Haematology, University College Hospital Medical School, London WC1E 6AU, England) — Lancet 1:1266-1269 (June 7) 1975*

A follow-up of 35 patients with pseudopolythemia showed that symptoms, high packed-cell volumes, and low plasma volumes persisted in most patients. The death rate in these patients was six times greater than expected. Patients with pseudopolythemia are often regarded as having a good prognosis; however, this view should be revised in the light of these findings. About 15% had transient cerebral ischemic attacks.

**AB-2323-76**

Extrathoracic Bypass for Stenosis of Innominate Artery — Sethi GK (Veterans Administration Hospital, Oteen, North Carolina 28803), Scott SM, Takaro T — J Thorac Cardiovasc Surg 69:212-216 (Feb) 1975*

Stenosis of the innominate artery usually occurs in older patients in whom the risks of conventional, corrective procedures such as transthoracic endarterectomy or aorto-innominate arterial bypass grafting are quite high. An axillo-axillary bypass procedure was performed in a high-risk patient with innominate arterial stenosis who had repeated episodes of transient cerebral ischemia due to decreased blood flow through the right carotid artery and reversal of blood flow through the right vertebral artery. Postoperatively, he has had dramatic improvement in his symptoms. Because of its simplicity, avoidance of major thoracotomy, avoidance of temporary occlusion of the carotid artery, and excellent late results, axillo-axillary bypass procedure was performed in high-risk patient with innominate arterial stenosis who had repeated episodes of transient cerebral ischemia due to decreased blood flow through the right carotid artery and reversal of blood flow through the right vertebral artery. Postoperatively, he has had dramatic improvement in his symptoms. Because of its simplicity, avoidance of major thoracotomy, avoidance of temporary occlusion of the carotid artery, and excellent late results, axillo-axillary bypass grafting is being proposed as the procedure of choice for stenosis of the innominate artery.

**AB-2324-76**

Cerebral Vasospasm and Ruptured Intracranial Aneurysm — Millikan CH (Department of Neurology, Mayo Clinic, Rochester, Minnesota 55901) — Arch Neurol 32:433-449 (July) 1975*

The literature concerning cerebral vasospasm associated with subarachnoid hemorrhage (SAH) due to ruptured intracranial aneurysm contains no definitive study of patients to determine whether there is (1) any clinical picture consistently present coincident with known cerebral vasospasm, (2) any relationship between mortality and known vasospasm, and (3) any relationship between serious brain damage (morbidity) and known vasospasm.

To answer these important questions, experience with 198 consecutive acute SAH patients (every patient had a cerebral angiogram demonstrating one or more intracranial aneurysms) was studied. The experience with these 198 consecutive patients led to the conclusions that (1) there is no clinical picture consistently present coincident with known cerebral vasospasm; (2) cerebral vasospasm has no effect on the mortality from SAH due to ruptured aneurysm; and (3) there is no relationship between the frequency and severity of the complications from surgical or conservative treatment and the presence or absence of vasospasm.

**AB-2325-76**

Angiography in Intracerebral Cavernous Hemangioma — Lillequist B (Department of Diagnostic Neuroradiology, University of Umeå, S-901 85 Umeå, Sweden) — Neuroradiology 9:69-72 (June 18) 1975*

Only a few cases with proved cavernous hemangioma have been examined with rapid serial angiography and the subtraction procedure. With the use of this technique a group of angiographical signs can be found which makes it possible to make an accurate diagnosis of a cavernous hemangioma. The angiographical changes are discussed in three cases.

**AB-2326-76**

Giant Aneurysm of the Middle Cerebral Artery: Angiographic Analysis of Blood Flow — Sato O (Kanto Teishin Hospital, Tokyo, Japan), Kamitani H — Surg Neurol 4: 27-31 (July) 1975*

The authors report a giant aneurysm of the middle cerebral artery with subarachnoid hemorrhage and without intraluminal thrombosis; by serial angiography, the turbulent blood flow within the aneurysm was demonstrated. The aneurysm was clipped successfully.

**AB-2327-76**

Cerebral Blood Flow, A Predictor of Recovery From Ischemia in the Gerbil — Osborne RC, Halsey J, Jr (Department of Neurology, Stroke Research Center, Birmingham, Alabama 35294) — Arch Neurol 32:457-461 (July) 1975*

Cerebral ischemia was induced in gerbils by bilateral carotid ligation for periods of 10 to 40 minutes. Cerebral blood flow (CBF) was measured by hydrogen clearance. Following ischemia, ultimate clinical and electroencephalogram recovery could be predicted in every case within the first five minutes by recovery of CBF to at least 100% of the control level. In animals without EEG recovery, the postischemic CBF was always less than 80% of control and progressively declined to zero. Residual flow during ischemia appeared to minimize the likelihood of brain death. The determination of ultimate brain death appeared to coincide with a major circulatory abnormality that is probably microvascular.

**AB-2328-76**

Brief Hypoxia-Ishchemia Initially Damages Cerebral Neurons — Levy DE (Department of Neurology, New York Hospital-Cornell Medical Center, New York, New York
Rats were studied during cerebral hypoxic ischemia to determine whether neurons or blood vessels suffered the first damage. Ten or more minutes of unilateral carotid artery occlusion combined with systemic hypoxemia (Pao2, 21 mm Hg) produced neuronal but not vascular damage in the ipsilateral cerebral hemispheres of 18 of 29 rats (62%); two and five minute stresses caused no visible neuronal abnormalities. The longer exposures produced more widespread damage, and neuronal loss and gliomedermal reaction were evident after prolonged survival. Early neuronal changes correlated with abnormalities of motor behavior (P < 0.005). Despite neuronal damage that was sometimes extensive, vascular no-reflow developed in only one of 24 animals after 20 and 30 minutes of hypoxia-ischemia. Production of neuronal and neurological abnormalities in the absence of hypotension or vascular no-reflow indicates that hypoxia-ischemia initially damaged cerebral neurons.

**AB-2329-76**
Femoral Percutaneous Catheterization in Infants and Small Children for Cerebral Angiography — Numaguchi Y, Hoffman JC Jr (Emory University Clinic, Atlanta, Georgia 30322), Sones PJ Jr — Radiology 116:451 (Aug) 1975*

An improved technique of selective cerebral angiography for infants and small children is described. The needle is inserted approximately 45° to the skin in order to avoid subintimal placement of the tip. After good backflow is established, the guidewire is advanced to a position in the descending aorta. A No. 3 polyethylene catheter and 21-gauge scalp vein needle were most successful.

**AB-2330-76**
Relationship Between Adenosine Concentration and Oxygen Supply in Rat Brain — Rubio R, Berne RM (Department of Physiology, University of Virginia School of Medicine, Charlottesville, Virginia 22901), Bockman EL, Curnish RR — Am J Physiol 228:1896-1902 (June) 1975*

Since adenosine is present in normal brain tissue and cerebrospinal fluid and since it dilates the pial vessels, it is possible that adenosine, in addition to H⁺, is also a mediator of the metabolic regulation of cerebral blood flow. Evidence supporting this hypothesis was obtained under various experimental conditions characterized by a change in brain oxygen supply. The brain was frozen in situ by means of a small bone rongeur precooled in liquid N₂ and the tissue was processed for adenosine determination (nmol/g of tissue). Electrical stimulation of the cortex at 0, 15, 30, and 45 Hz yielded adenosine levels of 5.4 ± 0.7, 10.5 ± 1.7, 13.0 ± 1.2, and 9.0 ± 2.1 nmol/g. Arterial pressures of 87, 60, and 40 mm Hg gave adenosine levels of 7.5 ± 0.76, 13 ± 2.6, and 26.6 ± 3.3, respectively. Ventilation with 29.7, 20, 10.7, and 5.5% O₂ significantly increased the adenosine levels to 9.4 ± 3.0, 6.4 ± 1.2, 30.0 ± 9.3, and 63.3 ± 18.2 nmol/g, respectively. Hyperventilation significantly increased adenosine from 6.7 ± 1.0 to 11.8 ± 1.4 nmol/g. This increased adenosine level was reduced by addition of CO₂ to the ventilating gas mixture. Lactate, the main H⁺ donor, pyruvate, and cAMP changed in a fashion parallel to adenosine. However, cAMP showed only a small increase with increases in adenosine. These findings are in accordance with the concept that adenosine and H⁺ may act synergistically to regulate cerebral blood flow and that endogenous adenosine may exert a small effect on cAMP formation.

**AB-2331-76**
Effect of Hyperventilation on Dynamics of Cerebral Energy Metabolism — Kogure K, Busts R, Matsumoto A, Scheinberg P, Reinmuth OM (Cerebral Vascular Disease Research Center, Department of Neurology, University of Miami School of Medicine, Miami, Florida 33152) — Am J Physiol 228:1862-1867 (June) 1975*

Hypocapnia of moderate and extreme degree (Paco₂, 21.1 and 13.5 torr, respectively) was induced by hyperventilation in rats subjected to the closed system of Lowry in order to evaluate the effects on utilization rate of cerebral energy metabolites. The tissue levels of high-energy phosphates and calculated intracellular pH did not change, whereas glucose, pyruvate, and lactate increased significantly. The Lα/Py ratio and NADH/NAD⁺ ratio both increased in proportion to the degree of hypocapnia. Utilization rates of glucose, glycogen, and ATP were all significantly reduced by hypocapnia, whereas the utilization rate of phosphocreatine was increased. The rate of total high-energy phosphate use also diminished in proportion to the degree of hypocapnia. The constant value of the energy charge (0.94 ± 0.01) indicates that the energy production rate might also be reduced by hyperventilation; thus the intermediate metabolites and substrates increased. It is concluded that extreme hypocapnia reduces the rate of cerebral energy metabolism significantly.

**AB-2332-76**

Computerized transaxial tomography (CTT) is a non-invasive roentgenologic method that demonstrates the configuration of the intracranial contents, including the cerebral parenchyma and the ventricular system. Of 207 children examined by CTT, 53 later had neuroradiologic contrast studies or neurosurgical intervention, or both, and two came to autopsy. The neuroradiologic, surgical, and pathologic findings corresponded with the CTT findings in patients with large ventricles, supratentorial tumors, intracranial hematomas or cysts, and epidural collections. The correlation was less concordant in patients with intracranial vascular malformations or lesions involving cranial bones. CTT promises to be valuable for diagnosis of many intracranial lesions in children.

*Authors' abstract.
Increased Cerebral Blood Volume in Benign Intracranial Hypertension — Mathew NT (Department of Neurology, Baylor College of Medicine, Houston, Texas 77025), Meyer JS, Ott EO — Neurology 25:646–649 (July) 1975*

In two patients with benign intracranial hypertension, the regional cerebral blood volume was markedly elevated (mean of 85%) while regional cerebral blood flow was slightly reduced (mean of 10%). Reduction of cerebrospinal fluid pressure by removal of cerebrospinal fluid reduced the mean values of regional cerebral blood volume by 13% without significant change in regional cerebral blood flow. The abnormal regional volume and regional flow returned to normal concurrent with the clinical improvement. Venous engorgement and increased intracranial blood volume appear to play an important part in the pathophysiology of increased intracranial pressure in benign intracranial hypertension. A unified concept of the pathogenesis of benign intracranial hypertension is proposed.

Local Alterations of Hemostatic-Fibrinolytic Mechanisms in Reforming Subdural Hematomas — Labadie E (Neuropathology Division, University of Wisconsin, Madison, Wisconsin 53706), Glover D — Neurology 25:669–675 (July) 1975*

Multiple chemical and coagulation determinations were undertaken on the subdural hematoma fluid from the reformed effusions of two patients. It was found that plasma or blood repeatedly reentered the subdural cavity. Coagulation studies compared the in vitro effects of subdural fluid with those of cerebrospinal fluid, serum, and a buffer control. Despite some chemical differences, the subdural fluids from both patients behaved similarly by (1) accelerating the intrinsic clotting system, (2) producing defective clot formation, and (3) accelerating the fibrinolytic system. It is presumed that these continuous hemostatic-fibrinolytic alterations, acting in the subdural sac, may have important implications in the growth and reformation of subdural hematomas, and a hypothesis of the mechanisms involved is presented.

The Significance of Histamine H1 and H2 Receptors on the Carotid Vascular Bed in the Dog — Saxena PR (Department of Pharmacology, Faculty of Medicine, Erasmus University, Rotterdam, The Netherlands) — Neurology 25:681–687 (July) 1975*

Intra-arterial histamine produced a dose-dependent increase in common carotid blood flow due to an active vasodilation. A supramaximal dose of mepyramine (H1-blocker) only partially suppressed the effects of lower doses of histamine without influencing those of its higher amounts. Both metiamide and burimamide (H2-blockers) effectively antagonized the mepyramine-resistant carotid vasodilator responses to histamine. The results permit us to conclude that two distinctly different types of histaminergic receptors (H1 and H2) are present in the carotid vascular bed and both of these receptor types are equally important in subserving histamine vasodilatation. This fact may explain why, despite incriminating evidence for a pathophysiologic role of histamine, the usual antihistaminic agents are rather ineffective in migrainous headaches. It is suggested that the use of both types of antihistaminic agents concurrently may provide a new approach to the treatment of migrainous headaches, particularly cluster-type headaches.

The Clinical and Pathologic Correlation of Fat Embolism Syndrome — Dines DE (Division of Thoracic Diseases and Internal Medicine, Mayo Clinic, Rochester, Minnesota 55901), Burgher LW, Okazaki H — Mayo Clin Proc 50:407–411 (July) 1975*

The fat embolism syndrome is a well-defined clinical entity that can usually be recognized in patients who have long-bone fractures. Cerebral symptoms of restlessness, confusion, stupor, and coma correlate with the autopsy findings of fat in the brain, but the amount of fat or amount of petechial hemorrhage cannot be quantitated with the severity of the cerebral symptoms. There is a correlation between the clinical manifestations of dyspnea and tachypnea and the autopsy findings in the lungs, which are heavy from edema and alveolar hemorrhage; however, we cannot correlate the degree of pathologic change in the lung, including lung weights, with the severity of findings clinically.
ABSTRACTS

AB-2338-76
Catecholamine Content of Cerebral Tissue After Occlusion of Middle Cerebral Artery in Cats — Cohen HP (Cerebrovascular Clinical Research Center, Department of Neurology, University of Minnesota, Minneapolis, Minnesota 55455), Waltz AG, Jacobson RL — J Neurosurg 43:32-36 (July) 1975*

The authors determined by fluorimetry the norepinephrine-epinephrine content (NE-E) of cerebral tissue from 38 cats, to ascertain whether constriction of hypersensitive arterial vessels by vasoactive agents in ischemic cerebral tissue could cause extension of cerebral infarcts and worsening of neurological deficits. Twenty-three cats had the left middle cerebral artery (MCA) occluded transorbitally, and ten cats had sham operations. Five cats had only the surgical procedures necessary for obtaining tissue; mean NE-E content was 0.30 µg/gm (SD = 0.041). For the other 33 cats, including those with sham operations, values were variable, ranging from 0.07 to 0.60 µg/gm. Low values usually were obtained for ischemic hemispheres 24 hours and seven days after MCA occlusion, but at other times values could be high or low on either side. Many factors unrelated to tissue damage, including arterial manipulation, influence the catecholamine content of cerebral tissue.

AB-2339-76
Mechanisms of Contractile Response of Cerebral Artery to Externally-Applied Fresh Blood — Simeone FA (Department of Neurosurgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania 19107), Vinall P — J Neurosurg 43:37-47 (July) 1975*

The authors report and analyze the in vitro contractions of fresh bovine cerebral artery on exposure to blood. The vessel does not contract significantly until blood clots on its surfaces; the contraction begins at the moment of clotting and is maintained as long as extracellular calcium is available. Comparative studies with vasoconstrictor amines suggest that serotonin, liberated from platelets by the clotting process, is responsible for this contraction and that the adherent clot itself concentrates the serotonin on the surface of the vessel. This contraction persists throughout the "viability" of the in vitro preparation, approximately ten hours. Serotonin is capable of producing this sustained contraction by increasing smooth muscle cell membrane permeability to extracellular calcium, which in turn activates native actinomycin.

AB-2340-76

Some carotid cavernous fistulas have been treated successfully with a balloon-tipped catheter. It would be ideal to leave an inflated balloon in the venous side of the fistula with preservation of the carotid flow. We were successful in preparing and leaving balloons in the venous circulation of the rabbit. We have treated a carotid cavernous fistula in a man effectively with such an isolated balloon but we were not able to preserve the carotid flow.

AB-2341-76
Moyamoya Syndrome Probably Associated With Hydrocephalus — van Damme W (Department of Radiology, St. Andries Hospital, B-8880 Tielt, Belgium), Beeckman P, Verbruggen R — Neuroradiology 9:39-42 (May) 1975*

A 12-year-old boy was admitted to hospital because of a convulsion. Neuroradiologically, he showed a picture of moyamoya disease. Bilateral hypoplasia of the internal carotid arteries is to be considered more likely responsible than an associated suspected hydrocephalus.

AB-2342-76
Survival After 40 Minutes' Submersion Without Cerebral Sequelae — Siebke H (Department of Anaesthesiology, Akershus Central Hospital, N1474 Nordbyhagen, Norway), Breivik H, Rød T, Lind B — Lancet 1:1275-1277 (June 7) 1975*

Cardiopulmonary resuscitation and rewarming were successful in a five-year-old boy who had been submerged for 40 minutes in ice-cold fresh water. Severe metabolic acidosis was corrected by intravenous infusion of sodium bicarbonate solution before spontaneous circulation could be re-established. Fulminant pulmonary edema developed after re-establishment of spontaneous circulation. This was efficiently reversed by positive-end-expiratory-pressure ventilation. During two days of treatment on a respirator the patient gradually regained consciousness; the endotracheal tube was then removed and the patient immediately started talking intelligently. The patient went through a period of slow cerebration and motor dysfunction but recovered rapidly, and on examination 13 months after the accident all findings were normal.

AB-2343-76
Anterior Inferior Cerebellar Artery Originating From the Cavernous Portion of the Internal Carotid Artery — Scotti G (Department of Radiology, Neurological Clinic, University of Milan, Milan, Italy) — Radiology 116:93-94 (July) 1975*

An anomalous branch of the cavernous carotid artery, not reported previously, is described. Its appearance and distribution were unlike those of any known cavernous branch, originating at the level where the trigeminal artery is usually found but having no communication with the basilar artery. Its distribution approximated that of the anterior inferior cerebellar artery. The author believes that this is an unusual form of persistent embryonic communication between the carotid artery and the vessels of the posterior fossa.

AB-2344-76
Lateral Projections With Inclined Head for Angiography of Basal Cerebral Aneurysms — Haughton VM (Department...
of Radiology, Milwaukee County General Hospital, Milwaukee, Wisconsin 53226), Rosenbaum AE, Baker RA, Plaistowe RL — Radiology 116:220-222 (July) 1975*

Inclined lateral projections prove useful in defining aneurysms situated about the circle of Willis. For these projections, the x-ray tube and film changer are positioned as for a true lateral projection. The MCA lateral projection (patient's head inclined away from the side of injection) is valuable in investigating aneurysms of the internal carotid artery, posterior communicating artery and middle cerebral artery trifurcation. The ACA lateral projection (head inclined toward the side of injection) may be used to define aneurysms in the region of the anterior communicating artery.

**AB-2345-76**

Biofeedback Treatment of Foot-Drop After Stroke Compared With Standard Rehabilitation Technique: Effects on Voluntary Control and Strength — Basmajian JV (Regional Rehabilitation Research and Training Center, Emory University, Atlanta, Georgia), Kukulka CG, Narayan MG, Takebe K — Arch Phys Med Rehab 56:231-236 (June) 1975*

The effectiveness of biofeedback training was compared to conventional physical therapy training in 20 adult hemiparetic patients with chronic foot-drop. They were randomly placed into two groups of ten patients each: the first group treated more than five weeks with therapeutic exercise and the second group treated more than five weeks with therapeutic exercise plus biofeedback training. In the second group receiving the biofeedback training the increase in both strength and range of motion was approximately twice as great as in the first group. The improvement displayed by even the first group of patients suggests that a potential for functional improvement exists that is often unexploited. The addition of biofeedback facilitates the process. Four patients in the biofeedback group achieved and retained conscious control of dorsiflexion; three of them are now able to walk without the use of their short leg brace.

**AB-2346-76**

Peroneal Nerve Stimulator in Rehabilitation of Hemiplegic Patients — Takebe K, Kukulka CG, Narayan MG, Milner M, Basmajian JV (Regional Rehabilitation Research and Training Center, Emory University, Atlanta, Georgia) — Arch Phys Med Rehab 56:237-240 (June) 1975*

Of nine hemiplegic patients having foot-drop who were test-treated with the Philips functional electronic peroneal stimulator, only the three who tolerated continued use of the stimulator for five weeks had improvement in function. Findings in these cases indicate that to be selected for trial use of a stimulator a hemiplegic patient should fulfill the following criteria: (1) be in the hospital, (2) be ambulant with or without a cane and/or short leg brace, (3) have no severe contracture of the ankle joint, (4) have no severe spasticity, (5) have no obvious lower motor neuron lesions, (6) be cooperative and intelligent, (7) have no severe manual difficulty (he should be able to put on the stimulator without assistance), and (8) be able to tolerate the discomfort from the stimulation.

**AB-2347-76**

Topical Lidocaine in Treatment of Cerebral Vasospasm — Giannotta SL (Section of Neurosurgery, University of Michigan Medical Center, Ann Arbor, Michigan 48104), Kindl GW, Haar FL — Surg Neurol 4:13-16 (July) 1975*

A 15-year-old girl died 14 days after hemiplegia suddenly developed. On arteriography, intimal separation of the middle cerebral arteries showed as a long attenuated column of dye — the "string" sign. Pathologic examination showed intimal separation starting at the distal bifurcation of the right internal carotid artery and extending into the middle and anterior cerebral arteries. The arteriographic string sign as evidence of dissection may aid diagnosis of this cause of childhood hemiplegia.

**AB-2348-76**

Arterial Stationary Wave Phenomenon in Tolosa-Hunt Syndrome — Kettler HL, Martin JD (Department of Neurology, West Virginia University Medical Center, Morgantown, West Virginia 26506) — Neurology 25:765-770 (Aug) 1975*

In a patient with Tolosa-Hunt syndrome, serial cerebral angiograms showed arterial stationary wave phenomenon and persistent deformity of the carotid siphon. Stationary arterial waves are noted in only 0.3% of cerebral angiograms and have not been reported in Tolosa-Hunt syndrome. In accordance with theories proposed by Theander and New, we felt that the intense stenosis of the carotid siphon produced by the periarteritis in our patient caused relative obstruction and high resistance, giving rise to resonance of arterial pressure waves and creation of the arterial stationary waves.

**AB-2349-76**

Vascular Malformations of the Pons in Children — Zeller RS (Departments of Neurology and Pediatrics, Baylor College of Medicine, Texas Medical Center, Houston, Texas 77025), Chutorian AM — Neurology 25:776-780 (Aug) 1975*

Three children reported here and an additional five patients from the literature with angiomas of the pons had a total of 19 clinical episodes of neurologic "illness." Thirteen...
AB-2351-76
Clinical Syndromes of Arteriovenous Malformations of the Transverse-Sigmoid Sinus — Obrador S, Soto M, Silvela J (Department of Neurosurgery of the Spanish Social Security and the Faculty of Medicine of the Autonomous University, Madrid, Spain) — J Neurol Neurosurg Psychiat 38:436-451 (May) 1975*

Arteriovenous malformations or fistulae shunting arterial blood from branches of the external and internal carotid and vertebral arteries into the transverse-sigmoid sinus may produce different clinical syndromes. The literature is reviewed with 96 patients including six personal cases. Usually these malformations have a congenital origin and only in 4% of the cases was there a previous history of a severe head injury. Clinical groups are defined and the role of angiography assessed. Direct surgical approach with occlusion or removal of the vascular malformation is the treatment of choice. Possible methods of treatment by selective embolization are discussed.

AB-2352-76

Two long-surviving cases of cortical blindness are described. One patient was able to detect sudden transitions from light to darkness and darkness to light. Both suffered from severe defect of recent memory, which lasted a month in one, and till death after nearly six years in the other. One patient survives. Necropsy findings on the other are given.

AB-2353-76
Analysis of Intellectual and Cognitive Performance in Patients With Multi-Infarct Dementia, Vertebrobasilar Insufficiency With Dementia, and Alzheimer’s Disease — Perez F1 (Department of Neurology, Baylor College of Medicine, Houston, Texas 77025), Rivera VM, Meyer JS, Gay JRA, Taylor RL, Mathew NT — J Neurol Neurosurg Psychiat 38:533-540 (June) 1975*

A prominent feature in dementia is intellectual deterioration. Review of the clinical literature indicates a lack of suitably quantitated studies of specific intellectual defects in dementia. The present study investigated the performance of patients with multi-infarct dementia (MID), dementia due to Alzheimer’s disease (AD), and vertebrobasilar insufficiency (VBI) with dementia using the Wechsler Adult Intelligence Scale (WAIS). Forty-two patients ranging in age from 45 to 85 years (x 66) were included. Significant differences in cognitive and intellectual performance were found between patients with dementia due to VBI and MID versus neuronal atrophy of the Alzheimer type. The group with AD performed significantly and consistently lower on all measures. There were no significant differences between the two cerebrovascular disease groups, even though the MID group performed consistently more poorly than the VBI group. A discriminant function analysis classified 74% of the patients correctly based on the individual WAIS scores. The diagnosis was more easily made when tasks measuring visual motor coordination and abstract reasoning were included in the analysis.

AB-2354-76
Brain Creatine Kinase in Blood After Acute Brain Injury — Somer H (The Wihuri Research Institute, Helsinki, Finland), Kaste M, Troupp H, Konttinen A — J Neurol Neurosurg Psychiat 38:572-576 (June) 1975*

Severe cold injury of the brain increased significantly both total creatine kinase and the corresponding brain isoenzyme (CKbb) activity in conflusin sinus samples. CKbb could be detected also in peripheral blood a few hours after severe brain injury in eight of 12 patients. Finding of CKbb in human plasma may prove a useful indicator of severe brain injury.

AB-2355-76
Spontaneous Extradural Haematomas — Sanchis JF, Orozco M, Cabanes J (Neurosurgical Unit, La Fe Hospital, Valencia, Spain) — J Neurol Neurosurg Psychiat 38:577-580 (June) 1975*

Spontaneous extradural hemorrhage may be due to neighborhood infections, vascular malformations of the dura mater, and disorders of blood coagulation. Two cases are described here: infection was present in one; in the other, there was a berry aneurysm of the middle meningeal artery with a small parietal dural angioma. Operation was successful in both patients.

AB-2356-76
Role of Cerebral Angiography in Vertebrobasilar Occlusive Disease — Caplan LR (Department of Neurology, Beth Israel Hospital, Boston, Massachusetts 02215), Rosenbaum AE — J Neurol Neurosurg Psychiat 38:601-612 (June) 1975*

The authors attempt to separate clinical subgroups of patients within the larger category of vertebrobasilar artery disease, and to indicate the present role of angiography in their recognition and management. Angiography is of use in separating posterior fossa occlusive vascular lesions from space-occupying lesions. In addition, by defining the locus and nature of the occlusive process, it may result in more rational treatment and prognostication. Subgroups of vertebrobasilar ischemia which have a favorable prognosis may be separable clinically or, in unclear cases, angiographically.

*Authors’ abstract.
AB-2357-76
Anatomical Variations in the Origin of the Posterior Cerebral Artery Demonstrated by Carotid Angiography, and Their Significance in the Direct Surgical Treatment of Posterior Communicating Aneurysms — Sengupta RP (Regional Neurological Centre, Newcastle General Hospital, Newcastle upon Tyne, England) — Neurochirurgia 18:33-42 (Mar) 1975 (George Thieme Verlag, publisher)*

The result of direct surgical treatment of posterior communicating aneurysms as with any other intracranial aneurysm is influenced by poor preoperative condition of the patient, early surgery after the hemorrhage, advanced age of the patient, and so on. It is well known that some patients, however, are affected worse than others. This paper reports that the patients with anomalous origins of the posterior cerebral artery demonstrable by carotid angiography are particularly vulnerable to these factors. Retrospective analysis of 30 patients with posterior communicating aneurysms illustrates the effect of this congenital anomaly on the result of direct surgery.

AB-2358-76

In patients with severe head injuries ICP, MAP and CBF were measured continuously. In most patients there was a positive vasopressor response to increasing ICP, but the ICP/MAP ratio varied considerably in individual cases.

CBF was diminished either by increasing ICP or by decreasing MAP. This effect was more marked with ICP above 40 mm Hg or MAP below 110 mm Hg. In terminal stages there was often a negative MAP/ICP ratio accompanied by massive cerebral hyperemia.

AB-2359-76

Indications for the occlusion of the extradural portions of the carotid and vertebral arteries with the Fogarty catheter are demonstrated in five cases of traumatic carotid-cavernous sinus fistulas, in one case of an extradural carotid aneurysm originating from the arterial portion of the carotid siphon, in one case of traumatic carotid-jugular vein fistula and vertebral artery aneurysm with an AV shunt at the level of the atlas, and in two cases of large tumors of the base of the skull extending into the cavernous sinus. The limitation of the method is shown in one case where the catheter could not be passed through a "high" kink of the carotid artery. "Low" kinking, at the typical site above the bifurcation, can be overcome by mobilization and stretching of the vessel while introducing the catheter.

AB-2360-76
Früh- und Spätbefunde nach Biobond-Beschichtung von intrakraniellen Aneurysmen (Early and Late Results After Coating Intracranial Aneurysms With Biobond) — Stöwsand D (Neurochirurgische Universitätsklinik, Keil, Federal Republic of Germany), Buhl K — Acta Neurochir 32:73-82, 1975*

Fifteen patients with intracranial aneurysms have been treated by coating the aneurysms with Biobond. Three patients died in the postoperative period. Only one patient had recurrent hemorrhage one year after operation. In this case the sac had not been wrapped completely at operation. Histological examination of this aneurysm revealed macrophage reaction and signs of slow disappearance of the plastic. Ten patients, who were followed up for a period of three to eight years after operation, had no recurrent hemorrhage and were in good clinical condition, eight of them doing full-time work. No complications caused by the material have been encountered. In five patients carotid angiography was performed after operation. In two cases the size of the aneurysm was diminished and in three cases the size of the aneurysm was unchanged. There were no signs of thrombosis or narrowing of the adjacent arteries. We believe that Biobond is suitable for coating intracranial aneurysms that cannot be treated by clipping or ligature. As Biobond in vivo seems to partially disappear after long periods, it should be applied in thick layers.

AB-2361-76
Upper Limit of Cerebral Blood Flow Autoregulation in Experimental Renovascular Hypertension in the Baboon — Strandgaard S, Jones JV, MacKenzie ET, Harper AM (Wellcome Surgical Research Institute, University of Glasgow, Garscube Estate, Bearsden Road, Bearsden, Glasgow, Scotland) — Circulation Research 37:164-167 (Aug) 1975*

The effect of arterial hypertension on cerebral blood flow was studied by the intracarotid 133Xe clearance method in baboons. The arterial blood pressure was raised in gradual steps with angiotensin. Baboons with renal hypertension of 8 to 12 weeks' duration were studied along with normotensive baboons. In initially normotensive baboons, cerebral blood flow remained constant until the mean arterial blood pressure had risen to the range of 140 to 154 mm Hg; thereafter cerebral blood flow increased with each rise in mean arterial blood pressure. In the chronically hypertensive baboons, cerebral blood flow remained constant until the mean arterial blood pressure had been elevated to the range of 155 to 169 mm Hg. Thus, in chronic hypertension it appears that there are adaptive changes in the cerebral circulation which may help to protect the brain from further increases in arterial blood pressure.

AB-2362-76
Alpha-Receptor Stimulation by Endogenous and Exogenous Norepinephrine and Blockade by Phentolamine in Pial Arteries of Cats — Kuschinsky W (Physiologisches Institut
AB-2363-76

The question regarding the existence of an alpha-adrenergic component of pial arterial tone was investigated using a micropipetting technique combined with the measurement of vascular diameter. Concentration-response curves for the alpha-receptor blocker, phentolamine, revealed no vascular reaction for a concentration range from $2.5 \times 10^{-11}$ to $2.5 \times 10^{-7}$M. At higher concentrations (up to $1.3 \times 10^{-7}$M) concentration-dependent dilations were observed. Constrictions of pial arteries induced by perivascular injection of $2.5 \times 10^{-8}$M norepinephrine could be reduced by 38% and 73% when phentolamine was applied simultaneously in concentrations of $2.5 \times 10^{-7}$ and $2.5 \times 10^{-6}$M, respectively, whereas constrictions due to $2.5 \times 10^{-6}$M norepinephrine were not reduced by $2.5 \times 10^{-7}$M phentolamine, indicating a competitive antagonism between norepinephrine and phentolamine for pial arteries. Stimulation of the cervical sympathetic chain (90 seconds, 10v, 1.4 msec, 20 Hz) induced constrictions of pial arteries (mean 12%) which could be reduced by two-thirds during the simultaneous application of $2.5 \times 10^{-7}$M phentolamine. Since the constriction induced by norepinephrine applied exogenously or released endogenously could be reduced by a concentration of phentolamine which had no vascular effect per se, we conclude that the resting tone of the pial arteries is not influenced by an alpha-adrenergic component under our experimental conditions. The dilations induced by high concentrations of phentolamine are believed to be nonspecific.

AB-2364-76

Thrombosis and Intracranial Tumors — Kayser-Gatchalian MC (Neurological Hospital, Mannheim, Federal Republic of Germany), Kayser K — J Neurol 209:217-224, 1975 (Springer-Verlag, publisher)*

Necropsy reports (344) of intracranial neoplasm from an autopsy material over 13 years were reviewed to study the relationship of intracranial tumors to vascular thrombosis. The incidence of venous thrombosis in intracranial tumors was found to be 27.5% while that of a control group without malignancies taken at random from the autopsy material was 17%. The difference gives a statistical significance of $P \leq 0.05$. The parameters of sex, surgical intervention, the malignancy and the histological type of the tumor apparently do not affect thrombus formation to a statistically significant degree. There is increased thrombosis frequency with increasing age. The presence of hemiparesis or hemiparalysis does not affect the incidence of thrombosis. However, it determines to a great degree the lateralization of the thrombus.

AB-2365-76


A 37-year-old woman suffered from headaches, right facial pain, double vision and occasional tinnitus. On examination there was only a slightly dilated right pupil, weakened corneal reflex and capillary bleeding from telangiectasia of both hands. Similar bleedings occurred in her mother (mouth and hands) and son (nose). The arteriography of the right carotid artery showed a cavernous sinus fistula with a small shunt. Steady compression of the carotid artery by hand caused a marked improvement in the subjective symptomatology.

AB-2366-76

Central Necrosis of the Spinal Cord Induced by Hyperbaric Oxygen Exposure — Balentine JD (Department of Pathology [Neuropathology], Medical University of South Carolina, Charleston, South Carolina 29401) — J Neurosurg 43:150-155 (Aug) 1975*

Seventy-six adult rats were exposed to 60 pounds per square inch gauge (psig) of oxygen on consecutive days until death. At autopsy, 17 of the animals revealed segmental foci of central necrosis of the spinal cord gray matter, often associated with small ball-shaped and flame-shaped hemorrhages in either the cerebral and/or lumbosacral enlargements. Paraplegia or quadriplegia were clinically
observed prior to death. The oxygen-induced spinal cord lesions are similar though not identical to those observed in experimental and human spinal cord trauma. These observations indicate that the therapeutic use of hyperbaric oxygen in patients with spinal cord injury has a potential danger of causing central spinal cord necrosis.

**AB-2367-76**

Oxygen Tension in Spinal Cord Gray Matter During Exposure to Hyperbaric Oxygen — Ogilvie RW (Department of Anatomy, Medical University of South Carolina, Charleston, South Carolina 29401), Balentine JD — J Neurosurg 43:156-161 (Aug) 1975*

Adult female rats were exposed to 60 psig of 100% oxygen for 60 minutes. Oxygen tensions in the gray matter of the lumbar-sacral enlargement of the spinal cord, electroencephalograms, electrocardiograms, and respirations were monitored before, during, and after the compression periods. Oxygen tensions were found to rise sharply to as high as 1,050 mm Hg during compression and remained at significantly high levels throughout the entire hour of exposure. These data support the hypothesis that spinal cord lesions induced by exposure to hyperbaric oxygen are the result of excessive tissue oxygenation.

**AB-2368-76**

Blood Flow in Normal and Injured Monkey Spinal Cord — Bingham WG Jr (University Hospital, Ohio State University, Columbus, Ohio 43210), Goldman H, Friedman SJ, Murphy S, Yashon D, Hunt WE — J Neurosurg 43:162-171 (Aug) 1975*

The authors used indicator fractionation techniques to determine blood flow in normal and bluntly traumatized spinal cords of Macaca rhesus monkeys. Normal flow rates were determined for several levels of spinal cord as well as differential values for white and gray matter from representative areas. Flow rates in traumatized tissue, obtained at several different time intervals up to four hours after injury, demonstrated marked differences in regional perfusion of the white matter and gray matter after trauma. Gray matter perfusion was nearly obliterated while white matter blood flow persisted and in fact was higher than uninjured controls. The findings do not support the concept of ischemia as a factor in white matter failure. If toxic pathobiochemical alterations are induced by trauma, it may be possible to reverse these changes by exploiting the preserved white matter blood flow for chemotherapeutic intervention.

**AB-2369-76**

Permeability Limitation in Estimation of Local Brain Blood Flow With \(^{14}C\) Antipyrine — Eckman WW (Membrane Transport Section, Division of Cancer Treatment, National Cancer Institute, Bethesda, Maryland 20014), Phair RD, Fenstermacher JD, Patlak CS, Kennedy C, Sokoloff L — Am J Physiol 229:215-221 (July) 1975*

Influence of capillary permeability on local cerebral blood flow (LCBF) estimated by the autoradiographic diffusible-

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*Authors' abstract.
ABSTRACTS

AB-2372-76
Scintillation Camera Studies of Isotope Flow in Arteriovenous Malformations — Johansson T (Department of Neurology, Södersjukhuset, Stockholm, Sweden), Bergvik A — Acta Neurol Scand 52:63-70 (July) 1975*

A significant proportion of arteriovenous malformations are still undetected on conventional brain scans. Dynamic scintillation camera studies have shown a pronounced and rapid isotope accumulation in these structures. By means of data processed flow studies, one can distinctly select the inflow phase, etc., display TV pictures in optimal phase, and make quantitative comparisons. Thereby, one can obtain a very probable diagnosis, even when the AVM is small or has the characteristics of a fistula which is not seen on routine scans. As the method is simple and not time consuming, it is well suited for clinical screening.

AB-2373-76
Effects of Vincamin on Cerebral Metabolism — Tesseris J (Department of Neurosurgery, Asclepion Hospital, Hellenic Red Cross, Athens, Greece), Roggen G, Caracalos A, Triandafillou D — Europ Neurol 13:195-202, 1975*

In this study the effects of vincamin (Pervincamine) on cerebral metabolism were investigated. Sixty subjects were tested. Vincamin was administered to 36, aminophylline to 32. No drug was given to the remaining 12 subjects who were used as controls. A definite increase in cerebral metabolism was observed in patients receiving vincamin by either intravenous or intramuscular injection. Practically no change in cerebral metabolism was detected in subjects treated with aminophylline.

AB-2374-76
Facilitation Through Hyperventilation of Therapeutic Effect of Pyrithioxin in Cerebral Infarct Patients — Stoica E (Institute of Neurology and Psychiatry, Academy of Medical Sciences, Bucharest, Romania), Enulescu O, Gheorghiu M — Europ Neurol 13:285-303, 1975*

A method of treatment consisting in administration of a neurodynamic drug, pyrithioxin, combined with a short period of hyperventilation (HV) was applied in cerebral infarct patients with hemiplegia. The combination was superior to pyrithioxin alone for the motor recovery of these patients. In some cases, it induced immediately a partial restoration of motility. The combination constantly brought about an increase in urinary excretion of norepinephrine and vanilmandelic acid, which failed to occur after pyrithioxin or HV alone. HV appears to facilitate the neural effects of the drug by promoting its transfer into the CNS.

AB-2375-76
Cerebrospinal Fluid Spectrophotometry and Computerized Transverse Axial Tomography (EMI Scanning) in Cerebrovascular Diseases. Comparative Study Between Two Actual Diagnostic Methods in Cerebrovascular Disorders — Kjellin KG (Department of Neurology, Karolinska Hospital, Stockholm, Sweden), Söderström CE, Cronqvist S — Europ Neurol 13:315-331, 1975*

Fifty-one patients with cerebrovascular diseases were examined by CSF spectrophotometry (CSF-SPE) and computerized transverse axial tomography (CTAT: EMI scanning), most cases being followed by several examinations. Specific diagnoses were detected in 98% (CSF-SPE) and 75% (CTAT) of the cases, generally by only one examination. In cases examined angiographically or by isotope encephalography, the corresponding figures were 50% and 0%.

The combination of CSF-SPE and CTAT examination obviously means a breakthrough in diagnosis of cerebrovascular diseases which is naturally a prerequisite for the more rational therapy of these common and frequently disabling disorders.

AB-2376-76
Serum Lipid Changes Following the Completed Stroke Syndrome — Hollander FD (Medical Records Department, Burnley General Hospital, Burnley, Lancashire, England), Shafar J, Burton P — Postgrad Med J 51:386-389 (June) 1975*

Levels of serum cholesterol and M-particle lipoprotein have been monitored in 26 patients after the onset of the completed stroke syndrome. Measurements were made regularly over the first four weeks and again at three months. A steady fall in serum cholesterol was noted which evened out after the ninth day and returned to the original level by the third month. M-particle lipoprotein showed no change in the first four weeks but a significant rise over the original level was demonstrated at three months.

Some implications of these findings are discussed and it is concluded that, if required, valid serum cholesterol measurements can be made following the completed stroke syndrome provided the blood sample is withdrawn within 24 hours of the acute episode. These findings accord well with those after myocardial infarction.

AB-2377-76
Enhanced Vesicular Transport of Exogenous Peroxidase Across Cerebral Vessels, Induced by Serotonin — Westergaard E (Anatomy Department C, University of Copenhagen, Copenhagen, Denmark) — Acta Neuropath (Berl) 32:27-42, 1975 (Springer-Verlag, publisher)*

Previous studies have revealed that the endothelial cells of cerebral vessels are linked by tight junctions preventing an intercellular passage of exogenous peroxidase. However, under normal conditions, vesicular transport of the tracer has been demonstrated in parts of cerebral vessels, especially in arterioles with a diameter of 30 to 100 μ. Solutions, containing 50 to 800 μg of buffered 5-hydroxytryptamine sulphate (serotonin), were perfused through the cerebral ventricles on mice after intravenous injection of horseradish peroxidase. Usually, the biogenic amine enhanced the vesicular transport of exogenous peroxidase. The serotonin-induced increased transport was observed in vessels on the surface of the brain as well as in vessels located in the parenchyma. No cell damage was observed. Increased
transport was observed in arterioles, venules, and capillaries. Therefore, it is not likely that the serotonin effect is a constriction of smooth muscle cells causing an opening of the tight junctions followed by an intercellular movement of tracer. The most reasonable assumption behind the mechanism is that serotonin affects the plasma membrane of endothelial cells resulting in an enhanced production and transfer of cytoplasmic vesicles.

ABSTRACT


Three cases of arterial pseudoaneurysm formation as a complication of percutaneous internal jugular vein catheterization are presented. Laceration of the posterior common carotid artery or thyrocervical trunk was the source for these lesions. The common antecedent event was the attempted cannulation of the internal jugular vein with the lateral approach. A transcervical rather than a transthoracic approach for treatment of these lesions was selected because of its low morbidity rate. This report documents another complication of internal jugular vein cannulation and recommends methods for prevention and successful treatment should it occur.

ITEMS OF INTEREST

Maxillary Artery Blood Supply to the Orbit: Normal and Pathological Aspects — Lasjaunias P (Department of Radiology, Fondation Ophthalmo logicque, Paris, France), Vignaud J, Hasso AN — Neuroradiology 9:87-97 (June 18) 1975


The Neuropathological Findings in Irreversible Coma. A Critique of the “Respirator Brain” — Walker AE, Diamond EL, Moseley J (Section on Head Injury and Stroke, Collaborative and Field Research, National Institute of Neurological Diseases and Stroke, Building 36, Bethesda, Maryland 20014) — J Neuropath Exp Neurol 34:295-323 (July) 1975

Normal Measurements in Angiography of the Posterior Fossa — Ross P (Department of Radiology, Medical University of South Carolina, Charleston, South Carolina 29401), du Boulay G, Keller B — Radiology 116:335-340 (Aug) 1975

*Authors’ abstract.
Abstracts

Stroke. 1976;7:93-104
doi: 10.1161/01.STR.7.1.93
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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