Cerebro-Pulmonary Scan Using ^{131}I-MAA As a Quantitation of Intracerebral Arterio-Venous Shunting

T. NAGAI,
Natoinal Institute of Radiological Sciences, Chiba
M. JIMBO and K. SANO
Department of Neurosurgery, University of Tokyo, Tokyo

Although some information can be obtained by a conventional cerebral angiographic technique, the potential value of angiography has not been fully exploited in the quantitative measurment of the blood flow through the vasucular malformation. In the present investigation we have developed a new radioisotopic technique with ^{131}I MAA for this purpose. This report is an assessment of the technique in seven patients and three angiographically normal subjects who received a total of seventeen intracarotid injections. By means of this isotopic technique, pre-operative measurements have been compared with those after neurosurgery in conjunction with cerebral angiography.

A dose of 50 microcuries of ^{131}I MAA, 20 to 100 microns in particle size, containing 0.05 to 0.5 mg of albumin, dissolved in 5 ml of warmed saline solution, was injected into the common carotid artery on the diseased side percutaneously. To prevent the accumulation of ^{131}I in the thyroid, 0.5 ml of Lugol's solution was administered orally before the injection. Immediately after the injection the uptakes of the compound were measured over the skull, over four parts of the lungs and over the liver. Profile scans from the top of the toe were performed in the supine position. Following profile scan, area scans covering the skull and lungs were performed in some patients.

For the uptake study, angiographically normal three subjects served as an in vivo calibration standard since correction need be made in counting efficiency for differences in size of the different organs. After measuring the uptakes, the exactly same amount of ^{131}I MAA was injected into the antecubital vein, and again the skull and lungs were measured with the same counting geometry. A calibration factor (f) was calculated as follows; $f = S_1/L_2 - L_1$, where S_1 is radioactivity of the skull after intra-carotid injection, and $L_2 - L_1$ is the net radioactivity of the lungs as a result of intravenous injection. In this study the sum of four individual radioactivities over the lungs was considered to be the radioactivity of the lungs. The calibration factor (f) was 0.3 in the three normal subjects.

Using following equation, the shunt flow through the malformation can be expressed in terms of percentages on the total blood flow in the common carotid artery on the injected side: relative shunt flow $= (f\ L/S + f\ L) \times 100\%$.

The relative shunt flow with this technique in normal subjects were 9.3, 5.7 and 10.7, while the values in patients before surgery (after surgery) were 76.7(54.2), 61.2(4.5), 62.4(8.9), 26.9(13.9), 54.0(13.7), 31.1(dead), and 26.0 (4.8), respectively.

The relative shunt flow and profile scan were very useful in quantitation of the shunt flow, because in normal cerebral circulation there can be no significant pathway for the labeled particles to traverse the brain microcirculation and lodge in the lungs. It is clear that this techniques can be taken as an index of the effectiveness of surgical procedures.

Our experiences indicate that this cerebropulmonary scanning technique served as valuable adjuncts to cerebral angiography. It is possible to say that this technique and cerebral angiography are different manifestation of the disease; the former being correlated with the dynamic blood flow through the vascular fistulae and the latter with the anatomical configuration of the malformation. Though several problems remain to be solved, we believe that the cerebro-pulmonary scan using ^{131}I MAA together with cerebral angiography will be valuable in making more accurate diagnosis of the disease and in assessing neurosurgical treatments.

In this study no brain insult was revealed

clinically, but great care must be taken about the safety in the human use of MAA by carotid injection. To measure the actual volume of the shunt flow, cannulation into the internal carotid artery and the direct measurement of the blood flow in the artery are now in progress, and the results will be reported in the near future.

Brain Blood Flow Measurement with ^{131m}I-Diiodo-Antipyrine

M. KITANO, M. KAGAWA, Y. ISHIDA, T. MINE and M. MIZUKAMI
Division of Neurological Surgery, Keio University, School of Medicine, Tokyo
H. TAKINO
RI Laboratory, Dinabott Co.

Antipyrine is one of the biologically diffusible indicators such as Xenon and Krypton, which cross over the capillary tissue membrane and distribute very rapidly within brain tissue water. The antipyrine uptake and elimination rates are determined by the effective capillary blood flow through brain tissue. The amount of tracer appearing in an externally monitored tissue is used as an indicator of proportion of cardiac output entering the tissue under examination. The present report describes the symmetry of the antipyrine uptake curve in the cranium as an indication of capillary flow following rapid intravenous injection.

About 300 subjects have been studied. In 30 subjects without known neurologic disease the count rate derived from each hemisphere is within 5% of equality. 6 cases were asymmetric out of 153 control cases in which include noncerebral neurological disease and systemic neurological disease. In 96 cases of diffuse cerebral disease such as alcoholic, degenerative, epileptic disease, 14 cases are symmetric. 86 patients with clinically verified cerebrovascular occlusive disease have been examined. In 17 cases of recent cerebral infarction, a significant disease of blood flow in the diseased hemisphere seen in the following cases: 4 posttraumatic, 2 brain tumor (gliomas), 2 idiopathic epilepsies and 1 median nerve palsy.

Large arteriovenous shunts can be detected by an initial peak preceding the plateau on the count rate curve. This uptake test might allow a simple means of detecting A-V shunting. The initial peak is attributed to the failure of the isotope passing through the shunt to equilibrate with brain water as normally occurs upon passage through the brain capillary bed. This initial peak is aggravated following hyperventilation. This might be secondary to the shift of blood flow to the shunt from normal brain capillary. (intracerebral blood steal phenomenon).

In the study of brain isotope content in normals following carotid injection of antipyrine, the washout rate approximated those of ^{85}Kr and ^{133}Xe. However, largely because of recirculation of antipyrine, this tracer could not easily be substituted for the gaseous radioisotopes whose recirculation is negligible following arterial injection.

This antipyrine test is simple and atraumatic, and is suggested as a screening test or as a means of repeatedly studying a neurological population.