THE USE OF RADIOACTIVE IODINATED SERUM ALBUMIN IN THE LOCALIZATION OF INTRACRANIAL LESIONS*

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In recent years radioactive isotopes have been used increasingly in attempts to localize intracranial lesions.2,4,7 These studies are performed during the preoperative work-up of a patient and afford ready correlation with other diagnostic procedures, such as angiography, electroencephalography, pneumoencephalography, and ventriculography, which are carried out during the same period.

It is thought that the radioactive materials reach a higher concentration at the site of pathology because of a “disruption” in the blood-brain barrier. The blood-brain barrier represents a selective permeability of blood vessels within the central nervous system.4 This is probably resident either in the intima of the cerebral capillaries or in the sucker feet of astrocytes and excludes selectively many molecules and electrolytes from the nervous system while allowing the usual transcapillary exchange of metabolites to occur.

In efforts made to localize intracranial pathology with radioactive materials, two more or less independent lines of endeavor have evolved. The first of these, and the one with which we are concerned here, utilizes the differential “pooling” of such radioactive substances as diiodofluorescein (DIF) and iodinated human serum albumin (RISA) by tissues within the cranial cavity that possess a capillary intima with different properties of permeability than the surrounding “normal” capillaries which maintain the blood-brain barrier. External radiation detectors are used to localize these tissues. RISA was used exclusively in this series.

The other method of radioactive survey is one with which we have had no experience. It involves the injection of such substances as P-32 preoperatively, and the use of a Geiger-Müller counter at the operating table after a bone flap has been turned. This presupposes that the general area of the brain in which the tumor resides is known. Thus, if one cannot identify neoplastic tissue grossly, the probe-counter is inserted into the cerebral substance and mapping is performed. An increased uptake in an area suggests the presence of neoplasia. In attempting total extirpation it enhances the possibility of identifying residual nests of tumor which might otherwise be missed.5,6

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METHOD

Our procedure entailed the intravenous administration of 500 microcuries of RISA in adults and proportionately smaller amounts in children. This amount of radioactivity gave relatively high counting rates with scintillation counters. No deleterious effects were observed in any of our patients. All patients were premedicated with Lugol’s solution to protect the thyroid from the radioactive iodine liberated in the metabolism of RISA. It was found that a period of between 20 and 30 hours after injection represented the optimal time for localization studies.

Scintillation counters consisting of NaI (Tl) crystals attached to the requisite photomultiplier tubes, voltage supplies and recorders have been used as detectors throughout these studies. Scalars were used to record the total number of counts in a unit of time. Several methods of scanning with these detectors have been tried. The preliminary work used a skull filled with rice and sawdust to simulate a brain. This phantom brain was made uniformly radioactive by soaking in an I-131 solution. “Tumors” of various sizes and specific activities were placed in different positions within the cranium and localization was attempted. A few of the methods of scanning that have been used will be discussed briefly, with an evaluation of their worth.

One of the first attempts at localization in this laboratory used a single counter which moved about the head in a circular manner. The scans were made in both spherical and cylindrical coordinates with the detector kept at a fixed distance from the center of the head or an axis passing through this center. This method relies on a comparison of the observed isocount contours with the contours obtained from a “normal” scan. This procedure was discarded because of the time consumed in a scan and because it was necessary for the patient’s head to be held erect, a requirement that often cannot be met.

The next course of study utilized a pair of detectors which were fixed so that the crystals faced each other. With the median plane of the head placed symmetrically between the counters, the scan was made in a rectangular grid fashion. The tumor depth was determined from the difference in reading of the two counters. This method gave good results with a “brain to tumor” activity ratio as low as 5:1, unless it were in the center of the cavity. Although this procedure showed considerable promise it was discarded as many patients could not remain in a fixed position for the length of time that was necessary to complete a survey.

Because of the varied conditions under which patients have been surveyed, it has been found that the most flexible arrangement is the most satisfactory. In all of the cases reported here the counter was mounted on a flexible arm so that it could be held perpendicular to the head. In a few instances the detector was kept at a fixed distance, but usually it was in contact with the head.

The patient was made to don a tight-fitting cap upon which numbers were