SCINTISCANNING AS A METHOD FOR LOCALIZATION OF CEREBRAL TUMORS*

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Since Moore5 introduced radioactivated diiodofluorescein as an aid in
the diagnosis and localization of intracranial tumors, there have been
numerous attempts to perfect a method whereby such tumors may be
localized with accuracy, facility, and without mortality. Belcher,2 using this
labeled chemical and a similar technique, was able to localize only 1 out of
20 verified intracranial tumors. Later Peyton et al.6 as well as Dunbar and
Ray3 reported the use of iodinated serum albumin (RISA). Counting rates
indicative of variable uptakes in tumors were observed. The impression was
gained that uptake of serum albumin was best detected in tumors in which
there was increased vascularity or increased capillary permeability. Evidence
indicative of radioactive substances entering the cells was not demonstrable.

For a period the procedures for localization were encumbered by multiple
point counting techniques such as suggested by Langer and Loevinger.4
Subsequently Sweet and Brownell7 reported a system of scanning in a
horizontal plane and localized tumors with acceptable accuracy. The dis-
advantages of their method were: the initial expense of equipment, com-
plexity of operation, and the need to be near a source of As74. Allen and
Risser1 described a refinement in technique by lowering the laboratory back-
ground count and selecting only the harder portion of the spectrum of 131
for analysis. This method is in need of further investigation.

In reviewing the literature on the subject of brain tumor localization with
the labeled iodine technique, it became apparent that a method was needed
to use material that was readily available and to employ simple technical
aids. By accomplishing this, intracerebral tumors could be scanned at modest
facilities and by personnel having a limited experience in electronics and
physics. Toward this end a scintiscanner has been designed (Fig. 1) which
has necessitated structural modification of an automatic scanning device
primarily used for scanning of the thyroid gland.

The head of the scintillation detector consists of a magnetic and lead shield which
is divided into two parts. The crystal is a Harshaw thallium activated sodium iodide
crystal, 3" in diameter and 1" in thickness. The crystal is coupled with a suitable

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cone of lucite to a RCA 6199 photo-multiplier tube. This tube feeds into a preamplifier, thence to a pulse amplifier which is coupled to a power amplifier which drives a cold cathode modulator tube. The glow modulator tube output may be recorded on photographic paper (Fig. 2). Collimation is selected to achieve maximum resolution.

**Fig. 1.** General view of the scintiscaner showing the patient beneath the focusing collimator.

**Fig. 2.** Schematic of the circuit. (A) High voltage supply. (B) Detector. (C) Pre-amplifier. (D) Pulse amplifier. (E) Power amplifier. (F) 150-volt regulated power supply. (G) 800-volt regulated power supply. (H) Light source.
in the 3.5" plane distal to the nose of the detector. This is obtained by choosing a shield having a 20° cone. The channels themselves have a width of 3/16". From the diagram (Fig. 3) it is readily appreciated that there is a cone of 20° of radiation dead space. This has been established by measurement of sources at the 3.5" plane and for distances less than this. Because of the width of this angle and the restricted collimation, the probability of the detector "seeing" a superficial vascular pool in the scalp, diploë, or cerebral cortex instead of a concentration in a deeply seated tumor is considerably diminished. In other words, the detector sees unequally at superficial levels while scanning to depth. Discrimination has not been employed to eliminate secondary radiation since deep tumors frequently exhibit considerable low energy phenomenon because of the Compton effect. The pulses received by the scaler may be recorded by statistical overprint with a telegraphic printer, a photo overprint using a Sylvania R 1131C tube, or by photoprinting with the frequency sensitive circuit previously described.

The material studied in this clinic has been, for the most part, gliomas of the cerebrum. Patients are prepared by blocking the thyroid gland by the oral administration of Lugol's solution followed by an intravenous dose of RISA (300–500 μc). Scanning is performed 24-48 hours later. Abnormal uptakes in the cerebrum on the side of the tumor have been found to occupy specific areas of the neoplasm. Sharp borders of the tumors have seldom been recorded, apparently because of regional necrosis of the brain and/or irregular invasion of adjacent tissue by the neoplasm.

Scanning to depth may be employed to advantage in examples of intracerebral tumors provided these lesions exhibit increased vascularization. This is especially true of neoplasms within the posterior cranial fossa. Here the overlying musculature and the great depth of the potential lesion make many methods of detection useless. Sweet and Brownell have stated that neoplasms of the posterior fossa elude diagnosis with I, K, and As, because of the masking effect of the overlying muscles. In our clinic, 3 out of 4 verified posterior fossa tumors were identified conclusively using our present technique, as described. Two of these were medulloblastoma and one was an angiomatous meningioma (Fig. 4). The remaining patient had a vascular malformation which was not detected. More recently, the circuit has been modified to record a "negative" print and using this technique an arteriovenous malformation of the frontal lobe of the left cerebral hemisphere has been recorded (Fig. 5).
Fig. 4. Positive print of a case of angiomatous meningioma of the posterior cranial fossa. This scan is in the posterior-anterior orientation of the head. The areas of increased density correspond to the localization pictured in the small diagram.

Fig. 5. Negative print of a case of an angiomatous malformation of the left frontal area of the cerebrum as viewed in the left lateral position of the head. The area of greatest activity is represented by the absence of printing.
A technique for automatic scanning of the head after intravenous injection of radioactivated iodinated human serum albumin has been described which has been successful in the localization of various types of brain tumors. This localization has been made possible by directional detection and a moderately sensitive recording device. It is hoped in the near future that the method will become effective for a greater variety of neoplasms by using a more sensitive electronic circuit and a more specific tumor metabolite.

REFERENCES