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The Percentage Uptake of Treatment Activity of I-131 by the Thyroid

In reply to the request of Dr. Charles L. Lewis in the *Journal* (*1*), our Department has, in most patients treated for thyrotoxicosis, established the 24-hr radioiodine uptake (RAIU-24) of the administered activity. The value of the treatment RAIU-24 was seldom equal to that of the diagnostic RAIU-24, being sometimes higher, sometimes lower than the latter. To date, I have not yet found a predictor for this behavior.

A remark in Dr. Lewis' letter, as well as the same tendency in some publications [e.g., (*2*)], prompts me to explain why we obtain the treatment RAIU-24 as a plea to all concerned to try to estimate—even if only roughly—the dose absorbed by the gland from the administered activity. To relate the outcome of the treatment to the administered activity (*2*)—instead of to the absorbed dose—helps little.

From any equation used to calculate the absorbed dose [e.g., see (*3*)], it can be seen that the following variables are important: the thyroid volume (or mass), the maximal uptake by the gland (usually taken to be the RAIU-24), and the effective half-life ($T\frac{1}{2}_{eff}$) of I-131 in the gland. To obtain the activity of I-131 needed to deliver approximately 3,500 rad, we do a preliminary calculation, using the diagnostic RAIU-24 and estimating the $T\frac{1}{2}_{eff}$. The thyroid volume is estimated by planimetry from the thyroid scan, and by measuring the gland's thickness either by ultrasound or, at present, on an oblique scan view. After the administration of I-131, RAIUs are repeated at 24 hr, and at 7 and 14 days. The delivered radiation dose is then recalculated, using the corrected RAIU-24 and the measured $T\frac{1}{2}_{eff}$. The difference between the preliminary and final calculations is sometimes remarkable.

This procedure does not give dose estimates as exact as one would wish and is open to many improvements (e.g., better estimates of the gland's volume, taking nonhomogeneity of radionuclide distribution into account, etc.). But, perhaps, the better the estimate of the absorbed dose by the gland, the more predictable the treatment results will become.

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Synthesis of Criteria for Operability in Normal-Pressure Hydrocephalus Due to Bilateral Convexity Block

For patients with the clinical syndrome of normal-pressure hydrocephalus, the prediction of success or failure of shunting procedures on the basis of intraventricular stasis of radioactive tracers has diminished of late. Jacobs et al. (*1*) found this procedure to be of no value. We wish to call attention, however, to an extension of criteria for shunting, based on a series of more recent observations by ourselves and others that may increase the likelihood of subjective and objective clinical improvement.

The first of these observations was reported by Harbert and coworkers (*2*), who noted that the cisternographic agent, Ytterbium-169 DTPA, yielded poorer outlines of the ventricular system than had the previously used agent, RISA. Harbert attributed this finding to absorption of Yb-169 DTPA by the brain substance and related this to the transependymal movement of the smaller Yb DTPA molecule.

The second relevant report was that of James et al. (*3*), who documented the presence of transependymal movement of radioactive tracers as an alternative route of cerebrospinal fluid absorption in experimental animal models.

Thirdly, additional information now provided in the evaluation of normal-pressure hydrocephalus by cranial computerized tomography indicates that at least some patients

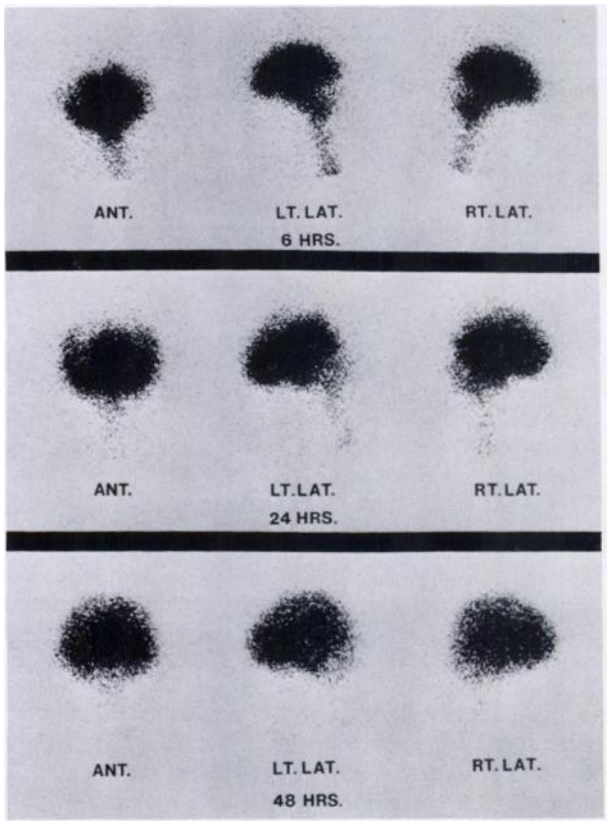

FIG. 1. Ytterbium-169 DTPA cisternogram showing bilateral convexity block to tracer migration, ventricular penetration of the tracer, and marked transependymal tracer migration by 48 hr. The cerebrogram is best evaluated by study of areas above and behind the ventricles on lateral views at 48 hr. Patient not improved after shunt.

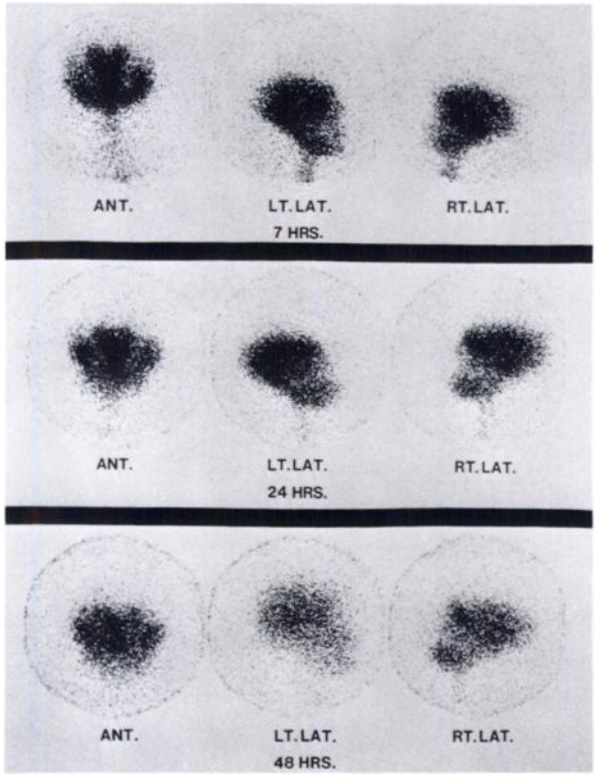

FIG. 2. Ytterbium-169 DTPA cisternogram showing convexity block and ventricular penetration, but no significant cerebrogram at 48 hr. Patient improved subjectively and objectively after shunt.

show periventricular low density (A. V. Messina, personal communication). These alterations in absorption values may diminish following CSF diversion.

Finally, our review of some 30 patients who have had computerized axial tomographic (C.T.) scans and cisternography with Yb-169 DTPA has led to the following observations. A group of patients with bilateral convexity block communicating hydrocephalus may be defined. On C.T. scans these cases demonstrate enlarged ventricles, enlarged Sylvian cisterns, and small or absent parasagittal cortical sulci. Cisternography demonstrates bilateral failure of radiotracer migration over the convexities to the vertex, and early (6 hr) ventricular penetration of Yb-169 DTPA. At this point the differentiation into two subgroups begins.

Those patients who will not benefit from shunting have C.T. evidence of large areas of periventricular low density, as well as large amounts of Yb-169 DTPA in the brain substance, producing a "cerebrogram" on the 48-hr cisternographic study. This excessive brain radioactivity, termed the cerebrogram, results in loss of ventricular detail (Fig. 1). By the time these findings are demonstrable, transependymal CSF absorption has become a chronic process, with irreversible changes occurring in the adjacent white matter. We believe that these patients have a compensated form of communicating hydrocephalus.

Opposed to this are the patients who have very little or no change in periventricular absorption values on C.T. images, and whose cisternograms with Yb-169 DTPA demonstrate persistence of ventricular activity at 48 hr with little or no cerebrogram effect. The alternative pathway for CSF absorption has not become irreversibly impressed, and shunting may lead to clinical improvement (Fig. 2).

Currently, we are following a small group of patients from both categories described above. To date six of these have been followed for 1 year with all of them behaving postoperatively according to the criteria outlined above.

We urge others to reevaluate their findings along these lines. Ultimately, a spectrum of changes on the radionuclide study ranging from no cerebrogram to marked cerebrogram should appear. A resurgence of interest in radionuclide cisternography, with Yb-169 DTPA or other small molecules as the radiotracers of choice for documenting CSF dynamics, seems likely to be the result.

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Computerized Transaxial Tomography and Serial Scintigraphy in Intracranial Tumors

The juxtaposition of the article comparing computerized transaxial tomography and cerebral serial scintigraphy in intracranial tumors (*1*) with the letter to the editor regarding optimizing brain scan sensitivity (*2*) is rather surprising. In the former article only "selected patients" had delayed images 2–3 hr after injection of pertechnetate, whereas in the latter article delayed images are stressed as a *sine qua non* for optimal imaging with either pertechnetate or the newer radiopharmaceuticals, DTPA or glucoheptonate. Additionally, numerous articles in the nuclear medicine literature attest to the utility of the vertex view (*3,4*), a projection that was lacking in the study of CTT in contrast to CSS. The value of this projection has been further enhanced with the newer radiopharmaceuticals, which have less concentration in the oropharynx than pertechnetate. Many nuclear physicians are justifiably irritated when state-of-the-art imaging methods such as CTT or ultrasound are compared with less than state-of-the-art radionuclide procedures, radiopharmaceuticals, and equipment. At the present time I think that the following radionuclide approach is the basic one to compare with CTT:

1. Cerebral radioisotope angiography using technetium DTPA or technetium glucoheptonate as the radiopharmaceuticals of choice. Either the anterior or posterior projection should be selected depending on the patient's clinical presentation.

2. Immediate static views in four projections (anterior, both laterals, and the posterior).

3. A minimum of 2 hr should elapse before the delayed static images are obtained, which would include a vertex projection.