those of Dr. Ryo. Indeed, one of the criteria we described for identifying thrombi was persistence of activity ("hot spots") for 5 min or longer.

The popliteal region is a difficult region in which to identify obstruction with certainty since when the patient's legs are extended, tension may be placed on the popliteal veins which impedes flow through this region. Our criteria for popliteal obstruction include visualization of collaterals on the dynamic study. If the activity appears to stop at the popliteal fossa and no collaterals are seen, then we repeat the injection with the patient's leg flexed.

Using the double tourniquet technique described, we visualize the superficial circulation so infrequently that we now consider its appearance abnormal.

With regard to the choice of collimators for venography, each institution must decide based on its own preferences what collimation suits its needs. Our experience with the multiple-injection technique and various collimators (including the 140-keV diverging) has left us with the opinion that the limiting factor in the image quality of venograms is counting statistics. We have therefore chosen the high-sensitivity (140 keV) collimator. Although it takes somewhat longer to perform the study we are able to keep our doses low and obtain excellent images.

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^{131}I-IHSA VERSUS ^{169}Yb-DTPA FOR "CISTERNOGRAPHY"

For radioactive tracer studies of the cerebrospinal fluid compartment to have any meaning, a clear understanding is required of just what is being measured by the tracer used.

In general, such studies are aimed at providing information on either the anatomy or the kinetics of the CSF compartment. The first category comprises qualitative imaging studies, i.e., CSF compartment scans, whereas the second category comprises quantitative nonimaging studies, i.e., CSF compartment kinetics. Although the two types of study may both be performed with the scintillation camera (functioning, respectively, in analog and digital capacities), CSF compartment kinetics may be investigated by direct sampling of the CSF (*1*) or vascular (*2,3*) compartments.

CSF compartment scans require a radiopharmaceutical which will be distributed throughout the CSF compartment. Almost any radiopharmaceutical that is moderately well retained in the CSF compartment will do (provided it fulfills the usual criteria for safety and has a radioactive label with reasonably suitable physical characteristics) since distribution of tracer throughout the CSF compartment is accomplished by what has been termed "bulk flow" of CSF.

In contrast, CSF compartment kinetics depend on diffusion and active transport as well as on bulk flow and hence depend on the physical and chemical properties of the constituent molecules of the CSF. Clearly, there is no single appropriate tracer for investigating the kinetics of the CSF since the CSF consists of a heterogeneous mixture of solute molecules (electrolytes, proteins, sugars, etc.) dissolved in a solvent (water). Each of the components has its own characteristic molecular properties and it follows that each of the components has its own characteristic kinetics. It is a fundamental axiom of tracer kinetics that the tracer used should accurately duplicate the behavior of the molecule under study in the physical or biologic system concerned. An appropriate tracer for CSF sodium is therefore ^{24}Na, for CSF albumin, ^{131}I-IHSA, for CSF glucose, ^{14}C-glucose, etc. Radiopharmaceuticals such as ^{169}Yb-DTPA and ^{111}In-DTPA, although satisfactory radiopharmaceuticals for CSF compartment scans, cannot be regarded as satisfactory tracers for CSF compartment kinetics unless they can be shown to duplicate accurately the behavior of one of the constituents of the CSF.

Comparative studies of inulin and albumin (*4,5*) suggest that clearance of a tracer from the CSF compartment varies with the size of the tracer molecule. Ytterbium-169-DTPA has a molecular weight of ~600 and albumin a molecular weight of ~69,000 and it is inconceivable that the kinetics of the two molecules are the same. Hosain, et al (*1*) measured clearance of ^{169}Yb-DTPA and ^{131}I-IHSA from the cisterna magna of dogs over 5 hr after cisternal injection of a mixture of the two radiopharmaceuticals.

They found little difference between the two up to 2 hr after injection but a tendency for the clearance curves to diverge between 2 and 5 hr, with the ^{169}Yb-DTPA having the faster clearance. Nevertheless, because the difference at 5 hr was not marked, they concluded that "clearances of labeled albumin and chelate from the CSF were similar." These results must be applied with caution to clinical studies which extend over 48 hr, particularly when the 24- and 48-hr measurements are generally accorded greater significance in calculating clearance than measurements at earlier time points.

Hosain, et al (*1*) also found that ^{169}Yb-DTPA injected into the lumbar subarachnoid space below a complete spinal block "was mostly cleared in two days." The same phenomenon has been noted in the author's laboratory. Hence, clearance of ^{169}Yb-DTPA from the CSF compartment even in this grossly pathologic situation is not much slower than normal. In contrast, ^{131}I-IHSA injected into the lumbar subarachnoid space below a complete spinal block disappears approximately ten times more slowly than in patients with communication to the upper subarachnoid spaces (*6*). It seems likely, therefore, that any differences between ^{169}Yb-DTPA and ^{131}I-IHSA are accentuated under conditions of defective CSF absorption.

A recent paper by Harbert, et al (*7*) shows some disturbing differences between ^{169}Yb-DTPA and ^{131}I-IHSA with respect to both anatomic delineation of the CSF pathways and CSF compartment kinetics. Their finding that diffusion of ^{169}Yb-DTPA into the cerebral tissue may obscure cisternal detail casts doubt even on the suitability of ^{169}Yb-DTPA for CSF compartment scanning. Timing of the arrival of peak activity in the head was also noted to be "strikingly different" with the two radionuclides, the ^{169}Yb-DTPA peak arriving on an average in half the time of the ^{131}I-IHSA peak. Although a trend towards faster clearance of ^{169}Yb-DTPA was noted, this did not reach statistical significance in the small series presented. Nevertheless, the marked difference in clearance noted in individual patients is not reassuring. For example, in one patient with normal pressure hydrocephalus, ^{169}Yb-DTPA activity fell from 94% of peak at 24 hr to 34% of peak at 48 hr (a relative drop of 64%), whereas in the same patient ^{131}I-IHSA activity fell from 100% of peak at 24 hr to 71% of peak at 48 hr (a relative drop of only 29%).

Further, more detailed comparison of the kinetics of these two radiopharmaceuticals is urgently required. In the meantime, whatever the relative merits of ^{169}Yb-DTPA and ^{131}I-IHSA for CSF compartment scanning, it is premature to suggest that ^{169}Yb-DTPA is a satisfactory tracer for CSF albumin in studies of CSF compartment kinetics. Until a better case can be made for ^{169}Yb-DTPA, the writer will continue to use ^{131}I-IHSA by cisternal injection for both high-quality scans and valid kinetic data.

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THE AUTHOR'S REPLY

Dr. Ronai's adjuration concerning ^{169}Yb-DTPA in studying CSF compartment kinetics should be carefully heeded. With regard to his comments about CSF scanning, we were careful in comparing ^{131}I-IHSA and ^{169}Yb-DTPA to ask ourselves whether our diagnostic impression would have been altered if we had used only a single tracer (Ref. 7, Ronai). In none of the 12 cases reported in that paper would