A Radioisotopic Test for Communicating Hydrocephalus

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Recently, there has been a rekindling of interest in hydrocephalus, due largely
to increased awareness of this condition in the adult. However, in adults, for two
reasons, it is often very difficult to diagnose symptomatic hydrocephalus. First, hydro-
cephalus in adults is usually secondary to or
associated with other intracranial lesions such as tumors, meningitis, or subarachnoid
hemorrhage, and, in these cases, it is difficult to
differentiate the symptoms and signs of the
hydrocephalus from those due to the primary
lesion. Second, available tests, including mea-
urement of the cerebrospinal fluid (CSF) pressure, dye studies, and radiography of the
ventricular system and subarachnoid spaces
using air or radioopaque material, often fail
to establish whether the hydrocephalus is due
to obstruction or atrophy. Measurement of
CSF pressure may not answer this question for,
as Adams, et al., have pointed out, the
CSF pressure may be normal in the presence
of symptomatic hydrocephalus.

Radiographic studies may also be inconclu-
sive. Hydrocephalus due to a complete block
within the ventricular system is readily diag-
nosed by air or positive contrast studies, but
when the block is incomplete and the ventricu-
lar system is only slightly larger than normal,
the diagnosis may be difficult. With com-
municating hydrocephalus, the diagnosis is
reasonably certain if the air study shows a
block in the subarachnoid space either in the
basal cisternae or over the cerebral convexi-
ties with failure of air to enter the sulci.
However, if the cisternae and sulci are in-
completely blocked and a few of them do
contain air, then diagnosis is difficult. Thus,
in many cases, it may be impossible to es-

tablish whether symptomatic hydrocephalus
is present. Further methods for studying CSF
dynamics are clearly needed.

Although several methods have been de-
vised over the past 50 years, none has gained
widespread use. In 1964, Di Chiro6–8 reported
a radioisotopic scanning technique for studying
CSF dynamics after the intrathecal
administration of radioiodinated human
serum albumin (\(^{131}\)I-HSA). Our initial experi-
ence using this method has been reported.15
This paper describes its application to the
diagnosis of communicating hydrocephalus.

Method

The tracer used was human serum albumin
labelled with \(^{131}\)I (with a specific activity of
approximately 5 \(\mu\)c/mg). It was diluted with
Elliott’s “B” solution and injected into the
CSF by lumbar puncture with the patient in
the lateral decubitus position, or by sub-
occipital puncture into the cisterna magna
with the patient sitting. For lumbar injection,
the dose was 100 \(\mu\)c \(^{131}\)I-HSA in 10 ml, and for
cisternal injection 100 \(\mu\)c in 5 ml.

After injection, the patient’s activity and posture were
not restricted. Scintillation scanning was performed using a Picker Magnascanner with a
3-inch sodium iodide crystal.
Anterior and lateral scans were obtained 2 hours after
lumbar injection, and almost immediately after
cisternal injection. Repeat scans were

performed at varying intervals up to 48 hours af-
after injection.

Because of the diminishing radioactivity
in the later scans due to physical decay of the
isotope, dispersion of the tracer in the sub-

arachnoid space, and absorption of tracer,
the sensitivity of the scanner was increased
for scans performed at later time intervals.
Therefore, the amount of radioactivity in
the scans is not strictly comparable, and this
factor must be considered when comparing
the amount of radioactivity in the individual
scans of a series. The radioactivity of serial
blood samples was measured in a well-type
scintillation counter in order to study the rate
of transfer of tracer from CSF to blood.

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Results

Normal CSF Scans. Diagrams of the normal intracranial subarachnoid space, and the corresponding scans in which the various cisternae can be identified, are shown in Figs. 1 and 2.

When $^{131}$I-HSA was injected into the subarachnoid space, a consistent pattern of flow and distribution of tracer was observed. Following injection into the cisterna magna (Fig. 3), most of the tracer flowed around the medulla to the cisterna medullaris and up into the cisterna pontis. Some flowed downward through the foramen magnum into the spinal subarachnoid space. From the cisterna pontis, there was diffusion laterally into the lateral recesses of the cisterna pontis, but the main flow was directed anteriorly and superiorly into the interpeduncular cistern. To reach above the tentorium the tracer took two different routes: posteriorly around the midbrain via the paired cisterna ambiens to reach subsequently the quadrigeminal cistern, or anteriorly into the suprasellar cistern. Usually there was good visualization of all the basal cisternae on the first scans, which were com-

Fig. 1. Diagram of a lateral view of the normal intracranial subarachnoid space (left) and a normal lateral scan performed 45 minutes after the cisternal injection of $^{131}$I-HSA (right). The letters are interpreted as follows: A = cisterna magna, B = cisterna pontis, C = cisterna interpeduncularis, D = suprasellar cistern, E = cisterna ambiens, F = quadrigeminal cistern, G = callosal cistern, H = cisterna lamina terminalis. The callosal cistern did not contain radioactivity in this scan.

Fig. 2. Diagram of an anterior view of the normal intracranial subarachnoid space (left) and a normal anterior scan performed 6 hours after the lumbar injection of $^{131}$I-HSA (right). The large accumulation of radioactivity in the midline is due to superimposition in this view of many of the basal cisternae. The letters correspond to those in Fig. 1; I = Sylvian cistern, which is well demonstrated at this time.