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Scanning of the Spinal Subarachnoid Space After Intrathecal Injection of ^{131}I Labeled Human Serum Albumin[1]

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A new method of "myelography" using ^{131}I labeled human serum albumin and gamma-ray scintillation scanning was first described by Bauer and Yuhl in 1953 (1,2). They studied 37 patients, 32 with suspected herniated intervertebral lumbar disks, in 25 of whom they were able to demonstrate lesions subsequently found at surgery.

In 1958, Perryman, Noble, and Bragdon (3) used the test 28 times ascertaining that lesions large enough to produce a partial or complete obstruction of the spinal canal can be shown by scintiscaning.

Bell and Hertsch used "radioactive myelograms" as an aid to the diagnosis of the level of spinal subarachnoidal blocks in small infants (4,5). Reyes and Ortiz (6) modified the technique in some of their 15 studies by combining the serum albumin with 2 ml of 10% dextrose, thus making the bolus "hyperbaric" so that it would move up or down within the subarachnoid space in response to tilting of the patient. In that paper they noted that "Russian neurosurgeons from the Institute of Neurosurgery in Moscow have used radioactive radon and xenon for isotope myelography." From Russia, Liass (7,8) and Koroluik (9) have reported on the use of intrathecal injections of radon. Liass counted at 3 cm intervals along the spine; Koroluik used a count-rate meter to record varying levels of activity on a strip-chart recorder as the probe moved sagitally along the spine. In the presence of a spinal-canal block, the radon bubble would stop at that level in its ascent and produce a sharp spike in the record as the probe passed over it. More recently, Pantazis and his colleagues reported the use of myeloscintigrams in 38 patients with "intraspinal neurological syndromes" (10).

In spite of the work just described, myeloscintigraphy has not been accepted as a clinically useful procedure largely because sufficient clarity of details could not be obtained by scanners heretofore available. Recently, newer and more refined scanning instruments have been introduced and become widely used.

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A significant refinement in the method is now possible with the Oak Ridge National Laboratory research scanner, and should also be possible with modern commercially available scanners. The practical application to clinical problems can therefore be reexamined. The technique described here has been tested on 16 patients.

METHOD

Fifteen drops of Lugol's solution are given 24 hours before the instillation of the ^{131}I labeled human serum albumin to prevent uptake of ^{131}I by the patient's thyroid gland. With the patient in the fetal position, a 22-gauge needle is inserted in the L3 or L4 subarachnoid space. Manometric determinations are made and 6 ml of spinal fluid are collected. The stylet is then placed into the needle. Approximately 100 μC of ^{131}I labeled human serum albumin[1] are withdrawn into a 5 ml sterile syringe. The usual volume for injection is approximately 1 ml. It is injected directly into the subarachnoid space; then the needle is removed, and the patient is allowed to return to his room. One to two hours later scanning is begun. The scanner (11,12) has a 3 inch crystal and a 37-hole gold focused collimator, tungsten shielded, that records digitally with a dot tapper and by pulsed photo recording. A speed of 0.2 inches per second is used, and the spectrometer set to record energies from 310 to 410 keV.

Scanning is begun from the tip of the os coccyx and carried upwards to the head. It takes about 45 minutes to complete the scan of the entire spinal canal. Scanning is repeated on the following day when possible or desired.

Surface landmarks are identified with a marking pencil at three places along the spine. The location of these pencil marks is transferred to the scans by operating the digital recorder at a high rate while the probe is located directly over the mark. At the completion of the scanning procedure, small pieces of lead are taped directly over the pencil marks, and AP and lateral roentgenograms are made of the entire spine. Any level of the scan can then be compared to its true anatomic location in relation to the vertebrae.

RESULTS

Six of 12 myeloscintigrams showed pathologic findings and six were considered to be normal. Three patients who had a normal myelogram were included to get some information about the appearance of a normal myeloscintigram. Table I summarizes the diagnoses of the individual patients, the indications for the procedure, and the result of the myeloscintigram.

Representative Examples:

Patient 1. The scans shown in Figs. 1a and 1b are from a 60-year-old Caucasian woman who had been treated for Hodgkin's disease for 12 years. While under treatment with vinco-leukoblastin, she developed a peripheral neuritis, urinary retention, and loss of bowel control. A lumbar puncture re-

[1]Obtained from Abbott Laboratories, Oak Ridge, Tennessee.

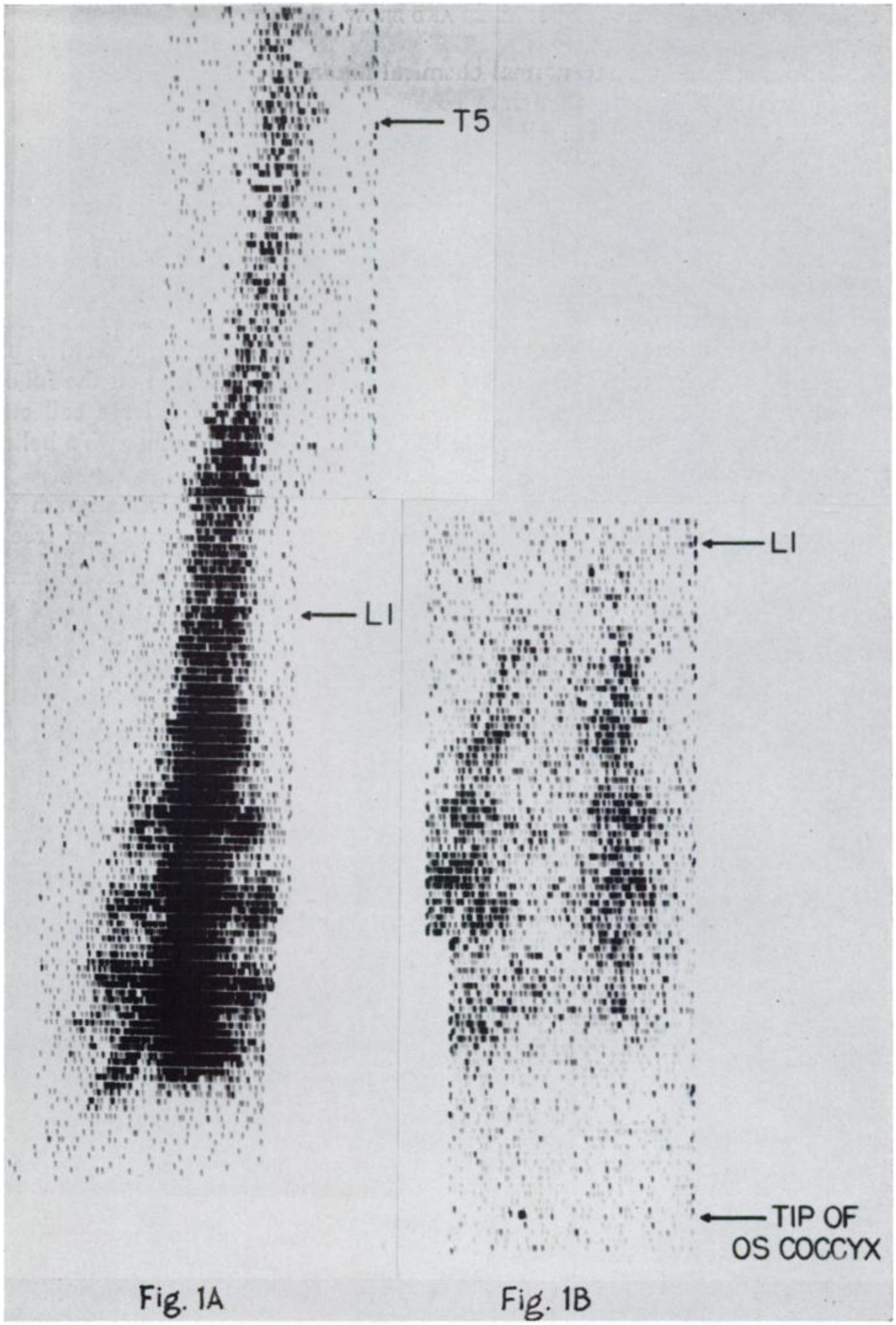

Fig. 1a. Normal myeloscintigram obtained 2 hr after intrathecal injection of 100 μC of ^{131}I labeled human serum albumin. The scan shows a moderate scoliosis, but is otherwise normal. The radioiodinated human serum albumin is distributed throughout the spinal canal and appears in the nerve root sheaths.

Fig. 1b. Most of the ^{131}I activity has left the subarachnoid space within 24 hr and has concentrated along the nerve root sheaths.

vealed normal pressure and normal chemical findings of the cerebrospinal fluid. The scans demonstrate a moderate scoliosis, but are otherwise normal. The radioiodinated human serum albumin dispersed spontaneously throughout the spinal canal within 1-2 hours. The scan done 24 hours later (Fig. 1b) revealed that the subarachnoid space was at background radioactivity, but concentration of the ^{131}I activity remained along the nerve root sheaths.

Patient 2. A spinal canal obstruction is shown in Fig. 2a. This scan was done on a 52-year-old woman with lymphosarcoma who developed rapidly progressive signs of cord compression. Both radioiodinated human serum albumin myelography and Pantopaque myelography (Figs. 2a and 2b) revealed a partial cord block at the same level in the thoracic spine. Scans done on the following day revealed a rather striking finding (Fig. 2c), in that a large collection of activity showed next to the spine in the exact area of the tumor. We believe that this represents capillary extravasation within the tumor.

This patient improved with local ^{60}Co teletherapy. A myeloscintigram was repeated six months later, when the patient was still asymptomatic and free of

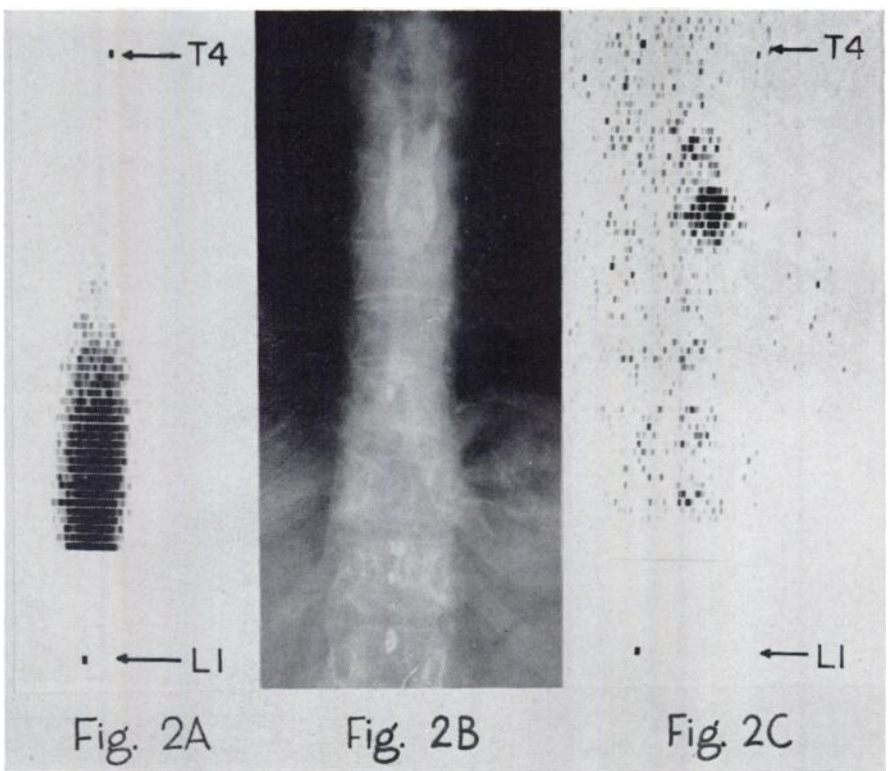

Fig. 2a. Radioiodinated human serum albumin myelogram showing a partial block in the thoracic portion of the spinal canal.

Fig. 2b. Pantopaque myelogram corresponding to Fig. 2a.

Fig. 2c. Scan indicating concentration of activity next to the spine in the exact area of the tumor 24 hr after the injection of radioiodinated human serum albumin.

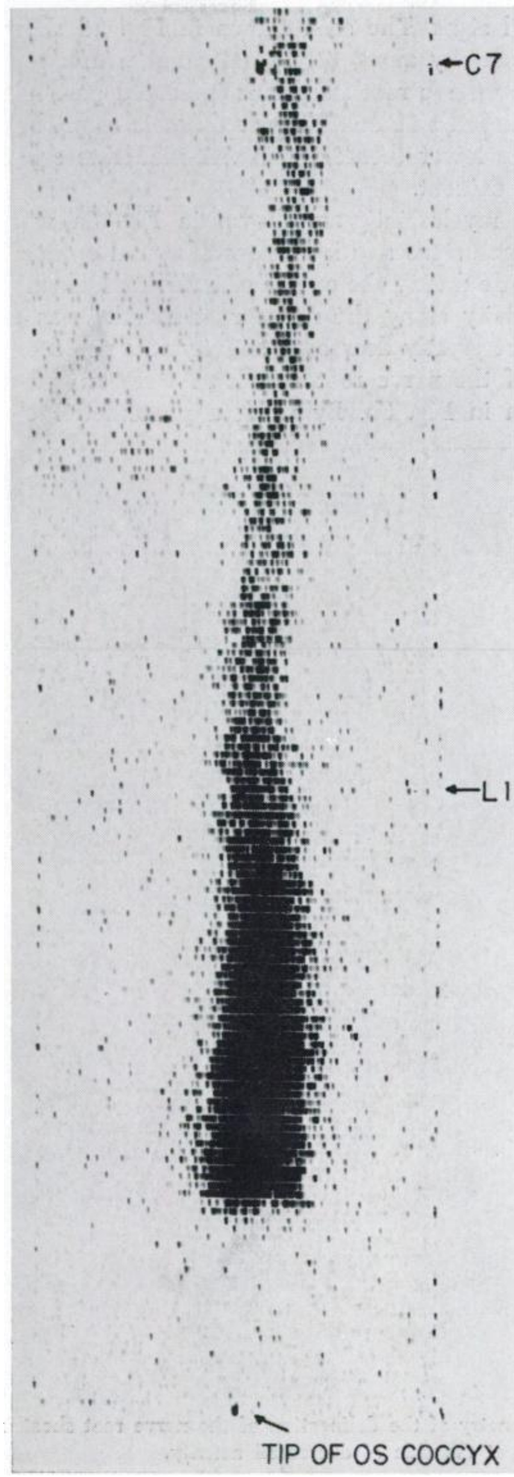

Fig. 2d. Normal myeloscintigram 6 months after irradiation to obstructing lesion at T5.

positive neurological signs. The scan shown in Fig. 2d shows spontaneous extension of the ^{131}I activity along the spinal canal within two hours. Spreading of the activity to the nerve root sheaths is indicated particularly in the lumbar area, and also on the left side of the lower thoracic spine, but is not distinct on the right side of the lower thoracic spine. A moderate scoliosis with the convexity to the right is evident.

Patient 3. The myeloscintigram shown in Fig. 3a was on a 27-year-old woman who developed signs and symptoms of spinal epidural infiltration of L1 to L3 on the right side during the course of an acute leukemia. Normal distribution of the ^{131}I activity along the nerve root sheaths was present on the unaffected left side, but greatly decreased activity was noted on the right side, indicating blocking of the nerve root sheaths. A "rescan" of the scan presented in Fig. 3a is shown in Fig. 3b. By using a photometric electronic rescanner,

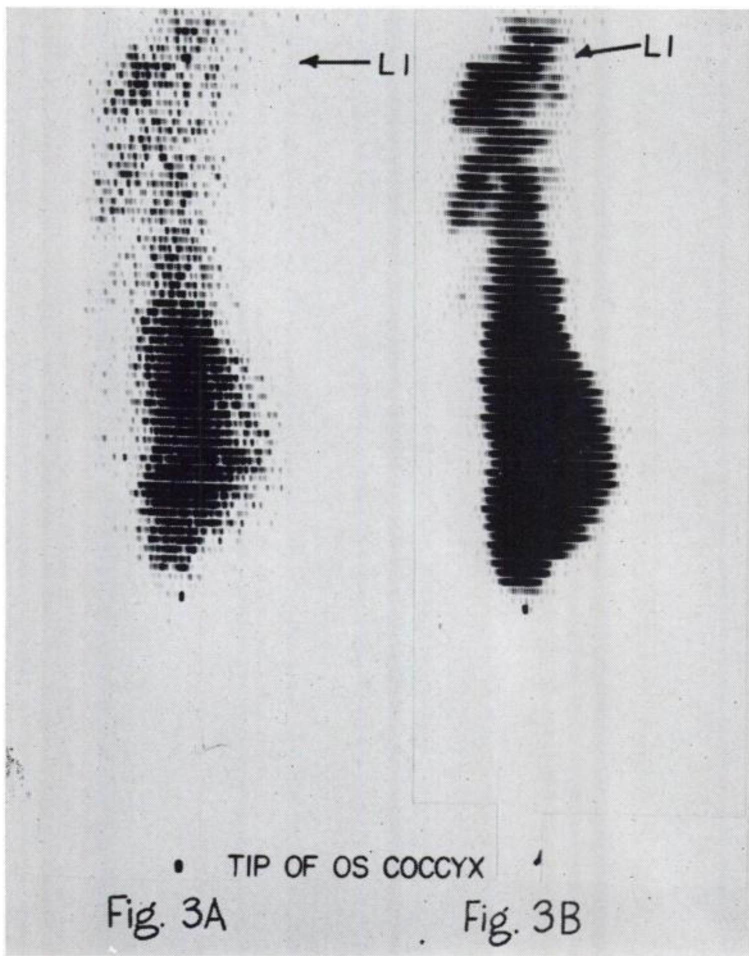

Fig. 3a. The asymmetry of the delineation of the nerve root sheaths indicating compression of the nerve roots at the side of decreased activity.

Fig. 3b. Electronic contrast enhancement rescan of the scan shown in Fig. 3a.

better enhancement of areas with increased concentration versus areas with decreased concentration can be achieved (12).

DISCUSSION

The limited number of myeloscintigrams done in this study does not allow a thorough evaluation, but the clarity of the scans produced here warrants the reevaluation of myeloscintigraphy. Although it is not suggested that the same clarity and delineation of cord lesions can be obtained with "radioactive myelography" as with contrast myelography, there are certain advantages to myeloscintigraphy: (1) Safety. The radiation dose has been estimated to be 3 rads to the surface of the spinal cord and 0.8 rads to the whole body. Myelitis, arachnoiditis, and other complications can occur in routine myelography (13,14). (2) The serum albumin need not be removed and tilting of the patient is not required, for the ^{131}I labeled human serum albumin spreads spontaneously throughout the spinal canal.

Radiation damage to the spinal column as described for thorium dioxide myelography (15) is not to be expected from ^{131}I particularly since it leaves the spinal canal rapidly (1,3,16,17).

SUMMARY

The technique of myeloscintigraphy after intrathecal instillation of radioactive iodinated human serum albumin has been used on 16 patients. The procedure is considered to be safe. With the newer and more efficient scanning equipment now in wide use, sufficient clarity and detail can be obtained to dem-

TABLE I

SUMMARY OF PATIENTS STUDIED

Pt	*Diagnosis*	*Indication*	*Findings*
1	Liposarcoma	Paraplegia	Complete block
2	Hodgkin's disease	Peripheral neuritis	Normal
3	Multiple myeloma	Paraplegia	Complete block
4	Lymphosarcoma	Paraplegia	Partial block
5	Lung cancer	Control	Normal
6	Hyperthyroidism	Control	Normal
7	Hypothyroidism	Control	Normal
8	Acute leukemia	Signs of spinal epidural infiltration	Nerve sheath obstruction
9	Breast cancer	Vertebral metastases	Normal
10	Prolapse of lumbo-vertebral disc	Symptoms	Filling defect on affected side (poorly localized)
11	Lymphosarcoma	Follow-up	Normal
12	Lymphosarcoma	Follow-up	Slight partial obstruction

onstrate relatively small lesions involving the subarachnoid space of the spinal canal. Myeloscintigraphy does not reach the quality and detailed information of contrast myelography, but is a useful screening method for the localization of intraspinal lesions which in some diagnostic problems will give the answer needed.

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