RADIONUCLIDE DEMONSTRATION OF SPINAL DURAL LEAKS

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Fistulae between skin and theca resulting in cerebrospinal fluid leakage in the thoracic or lumbar region were shown in two patients after intrathecal injection of \(^{111}\)I-human serum albumin at the upper cervical spine. This provides further evidence for caudal flow of CSF.

Radionuclide myelography has been used as an occasional aid in the localization of spinal block lesions. Bauer and Yuhl (1,2), when introducing this technique, showed its potential usefulness in cases in which the introduction of irritating foreign contrast media would be contraindicated (7). They suggested the use of 100 \(\mu\)Ci of radioiodinated human serum albumin (\(^{131}\)I-IHSA) which was administered either through cisternal or lumbar routes. This procedure has also been performed using \(^{203}\)Hg-chlormerodrin alone or in combination with \(^{131}\)I-IHSA (3) as well as high specific activity \(^{99m}\)Tc-albumin (4,5). Ytterbium-169-DTPA (6) and \(^{111}\)In in either colloidal solution or bound to transferrin (7) have been used for cisternography and may prove useful for radionuclide myelography.

Although myeloscinigraphic primarily has been used to localize complete spinal block lesions, partial block due to disc herniations also have been shown successfully (1,2,8). In large Russian neurosurgical centers, radionuclide myelography is the procedure of choice to confirm disc herniation (8). The present report concerns the use of the technique in showing the presence of spinal cerebrospinal fistula. The exact point of dural tear was shown and in one case the study marked the actual tract through which the leakage occurred.

CASE 1

This was the first Albert Einstein College Hospital admission for this 24-year-old black woman. She was admitted because of a draining thoracolumbar surgical wound. Approximately 11 years earlier, she became paraplegic because of injury in an auto accident. She was treated with physical occupational therapy. Two months before her present admission, she had a selective rhizotomy performed at another hospital to try and control flexor motor spasms of the lower extremities. Postoperatively, she developed a serosanguinous wound drainage. Two re-explorations as well as a lumbar peritoneal shunt were performed. However, drainage continued and she was transferred to this center for further evaluation and treatment.

On physical examination the patient was afebrile. Pertinent physical findings consisted of a poorly healed midline surgical wound extending from the spinous processes of D8 to L4 with wire sutures in place. There was active serosanguinous drainage from the central portion of the wound. The surrounding skin was atrophic and the underlying muscle mass was sparse. Marked thoracic kyphosis was present. Neurologically, there was total flaccid paraplegia with absent sensation up to the D3 level and absent reflexes.

Routine laboratory data were unremarkable. Plain spine radiographs showed defects due to bilateral laminectomies at the level of D11 through L2, inclusive.

In an attempt to establish the presence or absence of a cerebrospinal fluid cutaneous fistula, 100 \(\mu\)Ci of \(^{131}\)I-human serum albumin was injected into the subarachnoid space by a percutaneous C1-C2 puncture (9). Subsequently, the patient was kept in a sitting position for 2 hr. At 4 hr following injections, rectilinear scans revealed minimal uniform activity over the thoracolumbar spine. The basal cisterns were filled and appeared normal (Fig. 1, upper row).
At 24 hr, normal activity was noted over the convexity of the head and a spinal scan showed an area of increased activity in the thoracic region, which was most marked at the level of D7 (Fig. 1, lower row).

At 48 hr, a similar study was obtained with the additional finding of activity present down to the upper lumbar region. The dressings being used were also counted for radioactivity. At 24 hr the counting rate was not increased above background. However, at 48 and 72 hr, the sponges contained three and six times the background counts, respectively. This confirmed the presence of a CSF cutaneous fistula. A subsequent CSF culture was negative for bacteria.

Vigorous wound care was instituted using hydrogen peroxide and neomycin irrigations twice a day. Cerebrospinal fluid drainage stopped entirely by the third hospital week and has not recurred. The patient has returned to her previous independent status and has had no further drainage.

**CASE 2**

This was the first Bronx Municipal Hospital Center admission of a 50-year-old right-handed man who had sustained a stab wound of the low back 4 days before admission. He immediately noted weakness in the right lower extremity and was unable to walk. Neurological examination revealed inability to dorsiflex the right foot. There was no sensation to pin prick in the distribution of L5-S1 on the right. A 2-cm transverse stab wound was seen between the L5-S1 spinous processes. A serosanguinous fluid was coming out of the wound.

Although surgical attempts at nerve repair were not considered feasible, it was felt that surgery would be required (in order to prevent infection) should an active CSF leak be shown in the area of injury. Spinal puncture in the area of injury was felt to be inadvisable. Accordingly, a C1-C2 puncture was made and 100 μCi of 131I-human serum albumin was instilled. The CSF removed at the time of puncture was xanthochromic with 900 red cells, 7 white cells, a protein of 56 mg%, and a glucose of 55 mg%. A culture was negative.

The patient was kept in a sitting position for a period of 4 hr, after which Anger camera scintiphotos of the lumbosacral thoracic spine as well as the head were performed. Normal activity in the basal cisterns as well as a uniform spinal distribution was seen (Fig. 2, upper row). A dressing count was negative. Twenty-four hours after injection, a repeat study was obtained that showed a normal flow over the convexity of the head (Fig. 2, lower left). Over the spine, a CSF leak about one vertebral level above the stab wound in the skin was visible. Activity was present in the entire fistulous tract (Fig. 2, lower right).

Emergency surgery was performed. The ligamentum flavum was removed and a transverse dural...
laceration and a transected nerve root were seen at approximately one vertebral level above the area of the stab wound. Counts of the ligamentum flavum obtained at surgery were three times above that of the paravertebral superficial tissues removed at the same time.

The patient did well postoperatively but did not show any recovery from his neurological deficit.

**DISCUSSION**

Cerebrospinal fluid rhinorrhea studies with the scintillation camera have been previously described (10). In reviewing the literature, we have located only one previous report of a scintigraphic demonstration of a spinal leak. Gass, et al (11) relate that following a myelogram, a patient developed headaches that were incapacitating and persisted for 18 weeks after onset. Scans of the lumbar spine performed 20 hr after $^{131}$I-IHSA was injected through a cisterna magna puncture revealed a local hot spot at the site of original lumbar puncture that was confirmed at surgery to be a localized cerebrospinal fluid leak through the dura.

When $^{131}$I-human serum albumin is injected into the subarachnoid space, a consistent pattern of upward flow and distribution of the tracer in the basal cisterns and subarachnoid space around the convexity of the head is observed.

When the same tracer is injected into the cisterna magna or subarachnoid space at the C1-C2 level, most of the tracer flows around the medulla to the cisterna medullaris and up into the cisterna pontis and the rest of the basal cisterns. Some of the tracer passes downward into the lower spinal subarachnoid space (12).

Our observations from other radionuclide cerebrospinal fluid studies appear to confirm the bidirectional flow of the radioactive tracer. This would validate its use for the detection of spinal dural leaks after high cervical instillations of the tracer. In both of our cases the radioactive tracer was injected intrathecally at the level of C1-C2 out of necessity. In the first case, a lumbar puncture was contraindicated in view of the extensive necrotic surgical wound. The leak communicated with the surgical wound and this was further documented by the increased radioactivity present on multiple dressings. In our second case, the dural leak was shown to be one vertebral level above the stab wound on the skin. This finding was helpful in guiding the surgical approach. The cerebrospinal fluid cutaneous fistula was clearly shown as a tract on the scintiphotofluor and further confirmation of the dural leak was obtained by the positive counts in the ligamentum flavum.

It is important to note that the site of the dural leak was shown in both patients on the 24-hr study and increased counts on the wound dressings were obtained in the first patient after 48 hr. If $^{99m}$Tc-albumin is used as the tracer, a 1 or 2-mCi intrathecal dose will insure sufficient activity to obtain diagnostic 24-hr studies.

**ACKNOWLEDGMENT**

We wish to acknowledge the aid of Robert Grossman and Samuel Kasoff who were intimately involved in the care of the two patients reported here.

**REFERENCES**