RADIOISOTOPE MYELOGRAPHY IN DETECTION OF SPINAL FLUID LEAKS DUE TO DORSAL COLUMN STIMULATOR IMPLANTATION: CASE REPORT

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Radioisotope myelography can be used effectively for the detection of spinal fluid leaks following surgical procedures involving the spine and spinal cord. The advantages of this approach are discussed in relation to currently used techniques and are illustrated by a case report.

Since its introduction by Di Chiro, et al (*1,2*) in 1964, isotopic cisternography has gained wide acceptance for the study of cerebrospinal fluid kinetics. The technique has proven useful in the evaluation of a variety of cerebral disease states including all types of hydrocephalus (*3–6*), posterior fossa lesions and arachnoid cysts (*7,8*), subarachnoid hemorrhage (*9*), and cerebrospinal fluid leaks (*3,10*). It is also widely applied for determining the patency and efficacy of cerebrospinal fluid shunts (*3,11*).

To date, only a few reports discuss the use of radioisotope myelography for the evaluation of diseases involving the spinal cord and surrounding structures. Abnormal scan patterns have been illustrated with spinal cord tumors (*12–14*), disc herniations (*12,13*), arachnoiditis (*12,13*), hematomas of the cord (*15*) and arachnoid tears, particularly when associated with nerve root avulsion (*15–17*). Recently we were able to show that radioisotope myelography is well suited for the detection of subcutaneous spinal fluid dissection complicating the surgical implantation of dorsal column stimulators.

CASE REPORT

A 31-year-old man underwent amputation of his left leg above the knee for severe osteomyelitis. Postoperatively, severe stump pain persisted for a year. The pain was not relieved by stump revision and attempted neurinectomy. Hence, a dorsal column stimulator was implanted for pain relief.

FIG. 1. Dorsal column stimulator receiver implantation site is marked by scar just beneath right clavicle. Fluctuant swelling is present about receiver.

The electrodes were placed in the subdural space at the level of T_1-T_2. The receiver was implanted just below the right clavicle on the anterior chest wall. From the spinal electrodes, connecting wires passed in a subcutaneous tunnel over the right scapular area and over the right shoulder to the receiver on the anterior chest wall. In the immediate postoperative period, a fluctuant swelling developed at the receiver implantation site. Since this was believed to be spinal fluid accumulation resulting from spinal fluid dissection along the wire tract, the subdural electrode implantation site at T_1-T_2 was re-explored. An arachnoid tear was found and repaired. The fluctuant swelling at the receiver site persisted, however (Fig. 1), casting doubt on the premise that the swelling

Received Jan. 6, 1975; original accepted Jan. 23, 1975.

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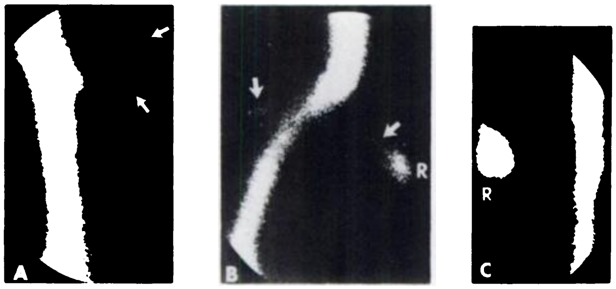

FIG. 2. (A) Posterior view of upper thoracic area shows origin of cerebrospinal fluid leakage as wedge of activity protruding to right of spinal activity. Diffuse activity extending from scapular region over right shoulder (arrows) marks course of subcutaneous tract. (B) Right lateral view of upper thorax shows part of subcutaneous tract (arrows) leading to large collection of activity at receiver site (R). (C) Anterior view of chest demonstrates distal subcutaneous tract with activity in cerebrospinal fluid about receiver (R).

represented the subcutaneous accumulation of spinal fluid. The patient was, therefore, referred to the Nuclear Medicine Division for diagnostic consultation.

Five millicuries of ^{99m}Tc-(Sn)DTPA were injected into the lumbar subarachnoid space. Posterior and right lateral scintillation camera images obtained 3 hr following injection showed the presence of the radiopharmaceutical along the entire wire tract from spinal electrode to the dorsal column stimulator receiver (Fig. 2A and B). The 3-hr anterior view of the right chest showed a large accumulation of the isotope at the receiver site (Fig. 2C). These findings clearly established that the subcutaneous swelling was due to spinal fluid that had dissected along the wire tract to the receiver.

The patient was treated with daily spinal fluid drainage and with pressure dressings applied to the anterior chest wall. The swelling gradually resolved.

DISCUSSION

One of the complications following surgical insertion of dorsal column stimulators is spinal fluid leakage from the subarachnoid space. Such spinal fluid leakage has been reported to occur with electrode implantation in either the subdural or the subarachnoid space (*18*). When leakage occurs, the spinal fluid can travel along the implanted wire, accumulate at the receiver site, and cause a soft-tissue swelling. Since significant fluid accumulation about the receiver can prevent the successful activation of the dorsal column stimulator, the recognition of such a spinal fluid dissection and its differentiation from a foreign body reaction are of considerable importance.

Currently employed methods for the detection of postoperative spinal fluid leaks include manometric studies, direct and chemical analysis of subcutaneous fluid aspirated at the site of swelling sometimes in conjunction with subarachnoid introduction of a dye, and radiographic myelography. These techniques often yield equivocal results and are not without risks. The use of radioisotope myelography for the detection of subcutaneous spinal fluid dissections offers several advantages over these currently employed techniques.

Radioisotope myelography is only minimally invasive. The subarachnoid space is entered only once by lumbar puncture for the introduction of the radiopharmaceutical. The occasional need for additional lumbar punctures for removal of contrast material in radiographic myelography and the needling of the subcutaneous space at the site of swelling to aspirate fluid are not needed in the radioisotopic procedure. With radioisotope myelography the spinal fluid dissection is directly visualized rather than inferred from subcutaneous fluid sampling. Radioisotope myelography with a short half-life radionuclide such as ^{99m}Tc or even ^{111}In exposes the patient to a smaller radiation dose than radiographic myelography which requires considerable use of fluroscopy during the examination and during the removal of the contrast material. Radiographic contrast material is a known irritant to the leptomeningeal membranes; the use of ^{99m}Tc-DTPA or ^{111}In-DTPA for cisternography has been remarkably free of complications (*19,20*).

The greatest advantage of radioisotopic myelography over radiographic (Pantopaque) myelography, however, rests with the very nature of the two indicators. The Pantopaque column is manipulated with the use of a tilt table and its location in the subarachnoid space is gravity dependent. Dorsally located leaks are difficult to define unless supine myelography is used. Moreover, since the bolus of contrast can only be maintained in a given location of the subarachnoid space (e.g., T_1-T_3 location) for a relatively short time period, only large leaks which allow prompt exit of the contrast material are likely to be recognized.

The radioisotopic tracer in the subarachnoid space is not subject to gravity. It flows with and diffuses through the spinal fluid and, therefore, has a good chance of defining a spinal fluid leak irrespective of its location anteriorly, posteriorly, or laterally. Equally important is the long time (over 12 hr) during which the radionuclide is present in high concentrations throughout the spinal subarachnoid space (*21,22*). Even small leaks may permit, over a period of many hours, enough isotope diffusion into abnormal fluid collections to allow their detection. For this reason serial imaging should be continued up to 24 hr after injection of the radioactive tracer if earlier views fail to disclose a suspected cerebrospinal fluid leak.

Radioisotope myelography can be performed either with the scintillation camera or a rectilinear scanner.

Any of the radiopharmaceuticals currently employed for cisternography can be used. Of these, ^{99m}Tc-DTPA offers particular advantages: its ideal gamma emission and its short physical half-life allow the best quality images for the lowest radiation dose to the patient. Radionuclides of longer physical half-life appear unnecessary since the 6-hr half-life of ^{99m}Tc still allows good quality imaging as late as 24 hr after injection. Technetium-99m bound to the chelate DTPA appears preferable to ^{99m}Tc bound to albumin since a low but definite incidence of aseptic meningitis has been reported following cisternography utilizing ^{131}I-human serum albumin and ^{99m}Tc-albumin *(20,23)*.

ACKNOWLEDGMENT

The opinions and insertions contained herein are the private ones of the authors and are not to be construed as official or as reflecting the views of the Navy Department or of the naval service at large.

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