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Delayed CT Metrizamide Enhancement of Syringomyelia Secondary to Tumor

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Six cases of syringomyelia associated with intramedullary tumor were examined by metrizamide myelography and delayed computed tomography. All cases showed opacification of syringomyelic cavities 7–24 hr after myelography. This finding suggests that metrizamide can pass through the cord substance from the subarachnoid space into a syrinx cavity in noncommunicating types of syringomyelia. It supports the theory of transneuronal passage of fluid as part of the origin of such cavities. These cases also support the thesis that, in patients with cord cavities, tumor can be excluded only if the cavity is demonstrated within all areas of cord enlargement.

Since the demonstration of delayed opacification syringomyelic cavities with metrizamide after its subarachnoid injection [1,2], neuroradiologic studies of patients have been revolutionized. The exact route of filling of these cavities is not understood, although direct communication between the subarachnoid space and the syrinx via the obex or some alternate structures [3] has been the assumed.

Syringomyelia associated with intramedullary tumor is not uncommon, being found in as many as 16.4% of a large autopsy series [4]. It has been assumed that enhancement of these cavities could not occur [5] because of the high protein levels usually found in cavities associated with spinal cord tumor.

We recently observed six cases of syringomyelia in association with intramedullary tumor, all studied with metrizamide myelography and delayed computed tomographic (CT) scans. The occurrence of delayed metrizamide enhancement of noncommunicating syringomyelic cavities clearly contradicts the theory of direct communication of cavities and supports an alternate mechanism of passage of metrizamide through the cord substance.

Case Reports

Case 1

A 25-year-old woman had a dull ache in the back of her neck for 4 years that had increased in severity during the previous 2 months with development of interscapular pain and a burning pain in the left hand. During the past year, she had noted decreased dexterity when typing.

Neurologic examination revealed absent deep tendon reflexes in the upper extremities and abnormal brisk deep tendon reflexes in the lower extremities. Power in the left upper arm was markedly reduced distally. Sensory examination demonstrated a loss of temperature sense from C3 to C8 on the left and a loss of pinprick sense from C8 to T10 on the left and from C7 to T1 on the right. Cerebrospinal fluid (CSF) examination (done at the time of myelography) revealed protein of 980 mg/dl. Metrizamide myelography (fig. 1A) showed intramedullary enlargement of the spinal cord from the lower thoracic region upward.

CT 8 hr after myelography did not show a cord cavity, but another CT scan at 24 hr showed a large "bull's eye" enhancement typical for syrinx in the thoracic cord (fig. 1B) [1]. No enhancement was demonstrated within the cervical cord. A syrinx puncture at the

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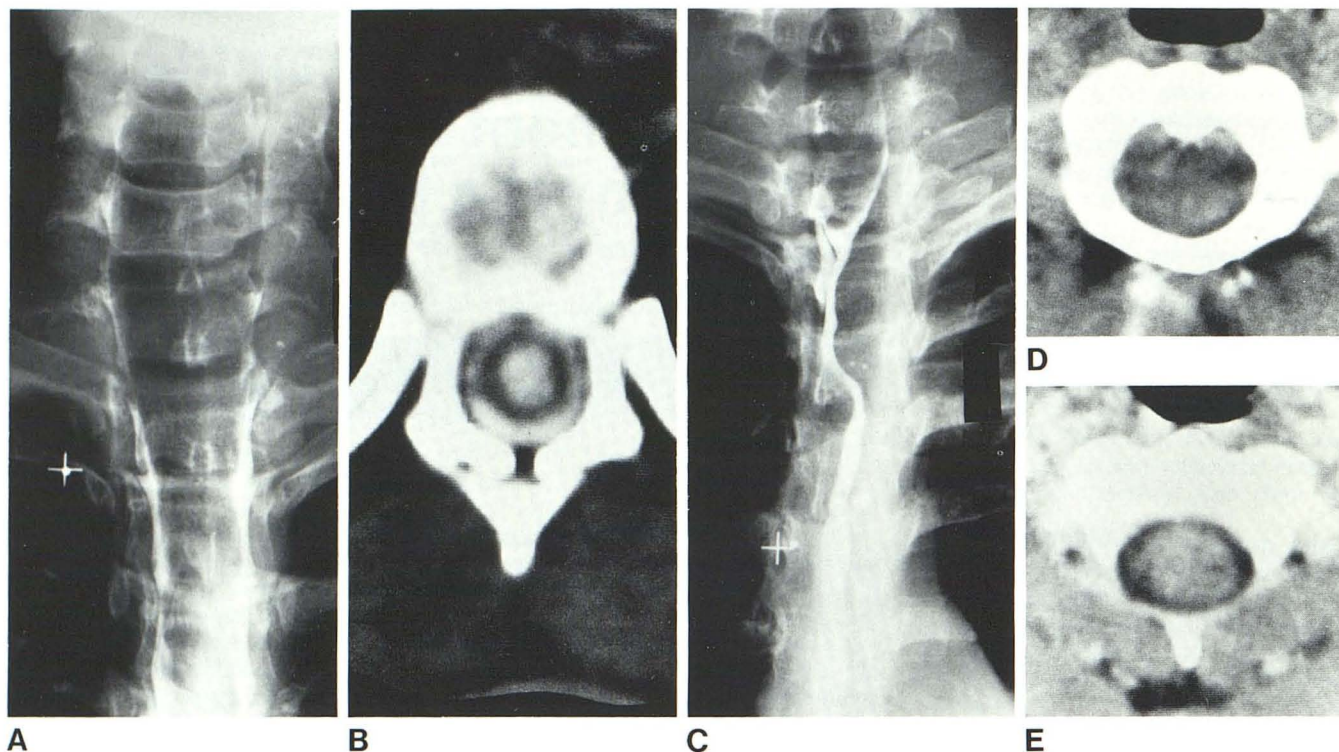


Fig. 1.—Case 1. **A**, Prone metrizamide myelogram. Enlargement of upper thoracic cord with almost complete obstruction in cervical region. **B**, 24 hr delayed CT scan. Large syrinx cavity in midthoracic cord. **C**, Metrizamide syringogram confirms lower pole of tumor mass blocking upper end of long

syrinx cavity. **D**, Cervical CT after syringogram. No contrast in cervical cord. **E**, After intravenous contrast injection. Diffuse enhancement of cervical cord tumor.

T7–T8 level 2 days later produced fluid with 2,460 mg/ml protein and degenerated glial cells, ependymal cells, and highly atypical cells. Metrizamide was injected through the puncture needle and the syrinx cavity imaged from T1 to T11. The upper border of the syrinx cavity demonstrated a tumor mass in this region (fig. 1C).

CT after the syringogram showed no contrast in the cervical cord (fig. 1D). After intravenous administration of contrast medium, diffuse enhancement of the cervical cord was demonstrated (fig. 1E) consistent with tumor.

At surgery, a myelotomy was done from T1 to C1, slightly to the left of the midline. A benign ependymoma extending from T1 to the lower medulla was entirely removed. The syrinx was seen to drain into the lower end of the myelotomy. The patient was clinically improved by the next morning.

Case 2

A 43-year-old man was well until 1 month before admission when he experienced gradual onset of interscapular pain that became progressively worse. At a community hospital, myelography was attempted with Pantopaque via a lateral C1–C2 puncture, and a syrinx cavity was entered. The fluid from the cavity showed 2,000 mg/ml protein and the contrast material outlined an irregularity in the midcervical region. He showed some fluctuating sensory findings and right arm weakness, and was referred for reevaluation 1 year later.

On neurologic examination there was slightly decreased power in the right biceps. Sensory examination showed reduction in temperature sensation in the left arm and reduction in pinprick sensation in the right arm and thumb.

Metrizamide myelography demonstrated marked enlargement of the cervical cord (fig. 2A). Delayed CT 11 hr after myelography did not show filling of a cord cavity in the cervical region but showed a high-density area in the upper thoracic cord (fig. 2B). A syringogram revealed a cavity extending from the upper cervical to the lower thoracic region. It was smooth except for a narrow part in the midcervical region (fig. 2C). The next day, CT of the midcervical region before and after intravenous injection of contrast material failed to show significant enhancement in the cord. A spinal cord glioma was assumed from the irregular outline of the cavity in the cervical cord and the extremely high protein level of the cyst fluid. Surgery was deferred because of the relatively good neurologic condition.

Case 3

A 35-year-old woman had had surgery for a fourth ventricular epidermoid tumor 10 years before. After a somewhat slow recovery she eventually regained almost normal function. About 2 years before this presentation she noticed numbness of the left foot, which gradually ascended to involve the whole left side including the face and head. She had also noticed some increasing clumsiness of her right hand and mild headache and diplopia.

On admission examination there was a persistent nystagmus and numbness of the left face. There was muscle wasting in the thenar and hypothenar eminence. Sensation was otherwise not significantly impaired. The deep tendon reflexes were normal.

CT demonstrated a large, nonenhancing, low-density lesion in the fourth ventricle suggesting recurrence of the tumor (fig. 3A) with mild hydrocephalus. Metrizamide myelography and delayed CT scanning were performed because of suspected syringomyelia.

Fig. 2.—Case 2. **A**, Lateral view of metrizamide myelogram. Enlargement of cervical cord. Oil contrast within cord (from previous study). **B**, Delayed CT at 11 hr suggests syrinx (arrow) in high thoracic cord. **C**, Syringogram. Metrizamide outlines large smooth cavity from C1 to C3, and below C4. Irregularly outlined cavity at C3–C4 (arrow) suggests tumor surrounding syrinx cavity.

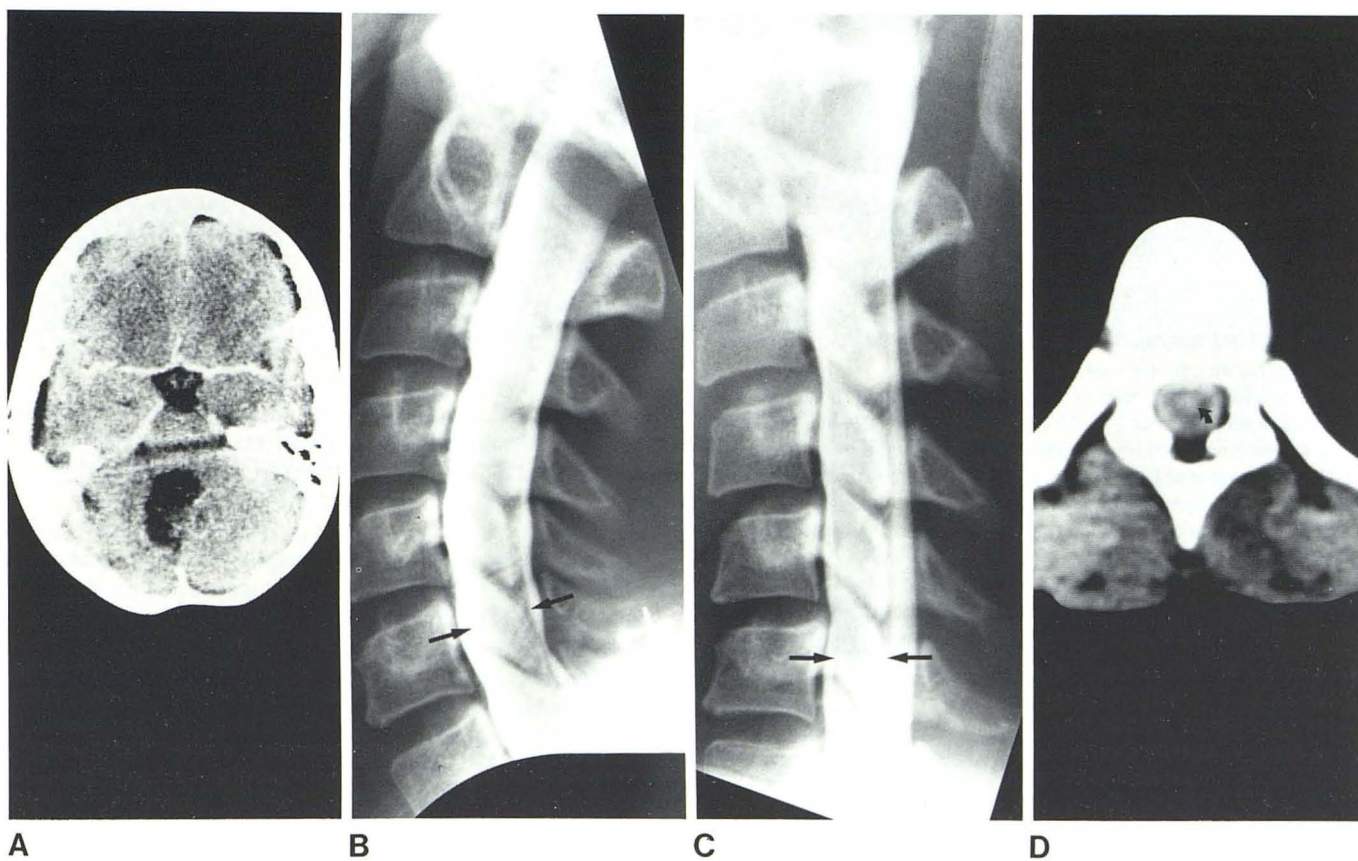
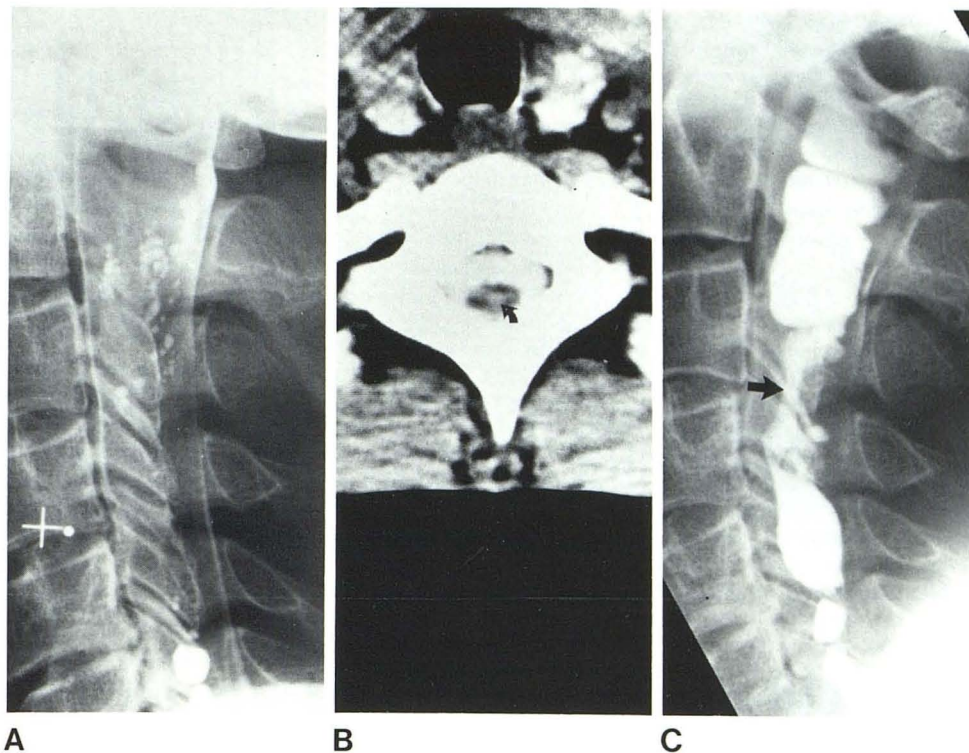


Fig. 3.—Case 3. **A**, CT scan with contrast. Nonenhanced low-density lesion in fourth ventricle. Prone (**B**) and supine (**C**) lateral views of metrizamide myelogram. Slight diminution in cord (arrows) at level of C6 in supine

compared with prone positions. **D**, Delayed CT scan at 11 hr. Syrinx cavity (arrow) in lower thoracic cord.

Prone myelography showed a normal-sized cord in the cervical region that diminished with the patient supine (figs. 3B and 3C) [6]. The 11 hr delayed CT scan demonstrated a syrinx cavity from the cervical region to the conus (fig. 3D).

At surgery, an epidermoid tumor that was filling and expanding the fourth ventricle was incompletely removed. No definite communication from the fourth ventricle via the obex to the cavity in the cord could be found.

Case 4

A 39-year-old man had noticed for 5 years that sneezing elicited a tingling sensation in his right hand and foot. Over the 1½ years before admission he noticed progressive dragging of his right foot and incoordination of both legs. In the 4 months before admission, he had difficulty in using his right hand.

On admission examination he showed wasting of the small muscles of both hands, associated with decreased power. Sensory examination showed decreased pinprick sensation in the right C8 and T1 distributions. There was decreased temperature sensation in the ulnar aspect of both hands.

Metrizamide myelography demonstrated enlargement of the cord from C1 to about the T4 level. Maximum enlargement was noted at C6–C7 (fig. 4A) with abrupt diminution below that. A change in cord size was noted at the C1–C2 level in moving from prone to supine [6]. A CT scan 7 hr after the metrizamide myelogram showed a syrinx cavity extending from C1 to C5 (fig. 4B). However, at the level of widest enlargement (C6–C7), there was no syrinx opacification. This strongly suggested a tumor at C6–C7. A total removal of an ependymoma extending from C5 to T1 was accomplished with subsequent clinical improvement.

Case 5

A 29-year-old man was seen with severe pain involving the left hand and arm. Subsequent investigations led to the resection of a spinal cord hemangioblastoma at C5 2 years later. At age 36 he underwent coagulation of a retinal hemangioblastoma and removal of a left cerebellar hemangioblastoma. He was admitted to the hospital 1 year later because of numbness, loss of position sense of the left foot, and gait disturbance.

On examination he had spastic quadriplegia most prominent on the left. There was dissociated sensory loss in the left arm, especially in the thumb, with mild loss in his legs.

Metrizamide myelography demonstrated intramedullary enlargement, the maximum at C4–C6 (fig. 5A). Selective spinal angiography showed two separate small vascular tumors, one at the level of C5 and the other at C6–C7 (fig. 5B). The tumors were much smaller than the enlarged cervical cord, implying an associated syringomyelia. Removal of the spinal cord tumors and evacuation of the syrinx cavity were performed.

The patient was reevaluated 1 year later with a metrizamide myelogram. Delayed CT scans at 7 hr (fig. 5C) demonstrated an atrophic cord with filling of the syrinx from the cervical through to the thoracic regions.

Case 6

A 31-year-old woman was well until 9 months before initial admission when she began to notice numbness in her left leg. Weakness and reflex changes in both legs and a sensory deficit below T2 were found. Myelography showed intramedullary and extramedullary masses in the cervical region (fig. 6A). An ependy-

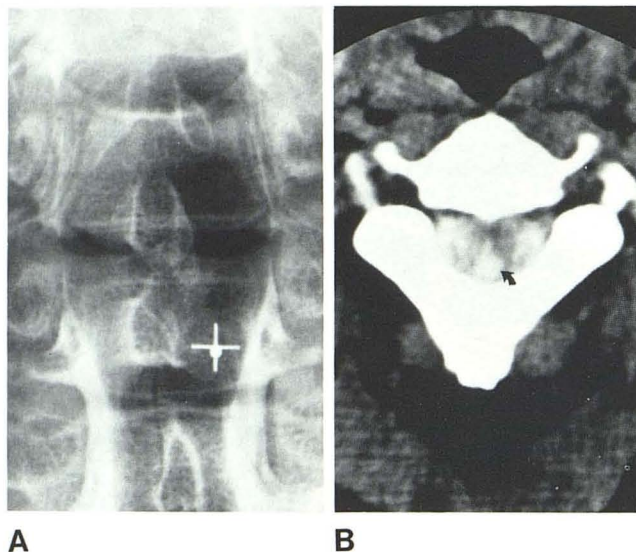


Fig. 4.—Case 4. **A**, Prone metrizamide myelogram. Enlargement of upper thoracic and cervical cord at C6–C7 suggests tumor. **B**, Delayed scan at 7 hr. Syrinx cavity in high cervical cord (arrow). No metrizamide was found in lower cervical cord where myelographic enlargement was greatest.

moma extending from C5 to T1 was found, but only partial resection could be performed. Postoperative radiation therapy was given.

About 2 years later she was readmitted because of progressive weakness and sensory loss. On examination she had weakness and spasticity of the legs, the right worse than the left. The sensory level had ascended to C6. Metrizamide myelography demonstrated cord enlargement greater than before at the operated levels (figs. 6B and 6C) and a change in cord size [6] above, suggesting a syrinx at C3 and C4. Delayed metrizamide CT at 10 hr (fig. 6D) confirmed filling of the syrinx cavity where the myelogram had demonstrated a change in cord size.

Discussion

The association of spinal cord cavitation and tumor is well known. The definition of syringomyelia as a "cavitation of the spinal cord which has a wall largely composed of glial tissue" was suggested by Barnett and Newcastle [7]. According to that definition, a cavity in the spinal cord partly lined with tumor cells is one of the forms of syringomyelia. An autopsy review by Poser [4] of 245 cases with a clinical diagnosis of syringomyelia revealed 40 (16.4%) cases of intramedullary tumor. This review also showed that the incidence of syrinx in 209 autopsy cases of intramedullary tumor was 31%.

The main aims of the neuroradiologic examination for intramedullary spinal lesions are to determine the levels involved, whether or not the lesion is solid, and whether tumor and syrinx coexist. It is also necessary to determine the exact extent of the tumor and/or syrinx. Cord collapse signifies a cystic lesion. This sign has traditionally been demonstrated by a two position gas myelogram [8, 9] or by a combination of oil and gas myelography [10]. Recently

Fig. 5.—Case 5. **A**, Metrizamide myelogram. Enlargement of lower cervical cord and thoracic cord. **B**, Left thyrocervical angiogram. Tumor stain (arrow) at C6–C7 level is considerably smaller than enlargement on **A**. **C**, 1 year later after removal of tumor. Delayed scan at 7 hr. Syrxinx cavity within small cervical cord (arrow).

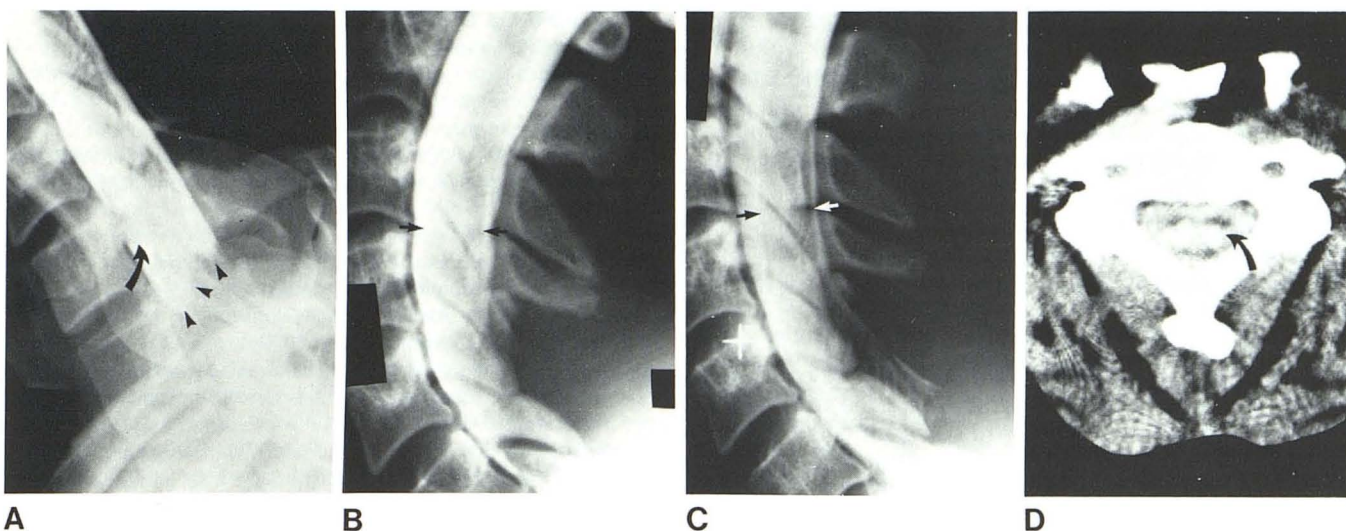
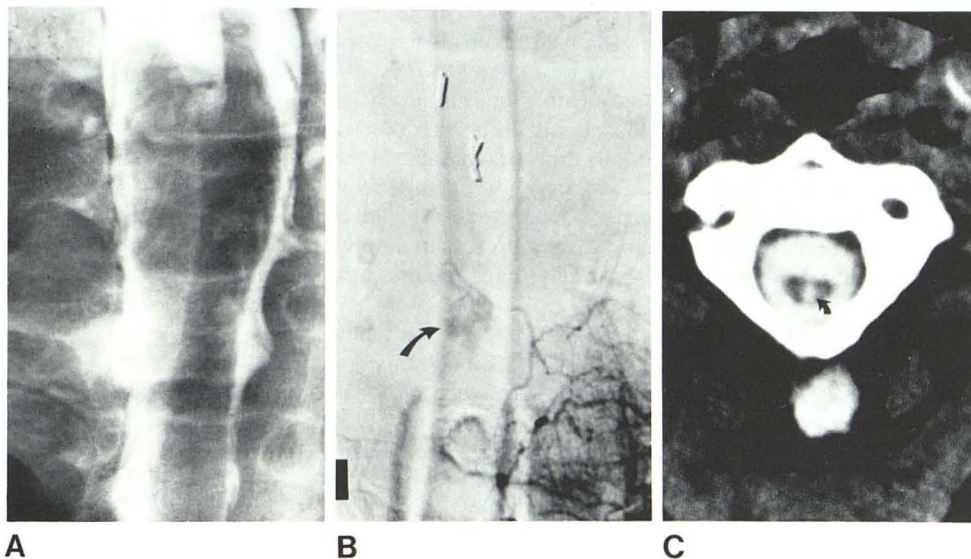


Fig. 6.—Case 6. **A**, Lateral view of original metrizamide myelogram. Block with cord enlargement at C7 (arrowheads). Anterior extramedullary intradural mass one level above at C6 (arrow). **B**, Prone (**B**) and supine (**C**) lateral view metrizamide myelography 2 years later. Cord enlargement at level of lami-

nectomy (C5 and C6). Cord is slightly enlarged C3–C4 in prone position, less so in supine (arrows). **D**, Filling of syrinx cavity (arrow) with metrizamide 10 hr after myelography.

this sign was demonstrated by water-soluble myelography [6].

It is usually difficult to determine if the tumor and syrinx coexist from a myelogram alone. In cases 4 and 6, however, the coexistence of the two conditions was suggested myelographically by an abrupt change in the cord width in the lower cervical region (suggesting tumor) combined with "collapsing cord" above (suggesting syringomyelia).

There are several methods for studying intramedullary spinal lesions by CT. A CT scan without intrathecal contrast material may demonstrate syringomyelia [11, 12], but there is still technical difficulty in demonstrating the complete

extent of a cavity or even showing it well in the thoracic cord. A CT scan with intravenous contrast administration may demonstrate an enhancing spinal cord tumor (case 1) [13, 14]. However, nonenhancement of a mass does not completely exclude the possibility of a spinal cord tumor associated with the syrinx (case 2).

CT scanning with intrathecal injection of water-soluble contrast medium demonstrates the cord size well and may show a syrinx cavity on delayed scanning [1, 2]. The mechanism for filling of a cord cavity by intrathecally injected contrast material is not clearly understood. It has been postulated that contrast material enters the fourth ventricle

and thereafter communicates with the syrinx through the obex. The Gardner [3] theory that hydromyelia develops due to abnormal fluid circulation between the central canal and the fourth ventricle because of an abnormal obex [3] supports that explanation. Another possibility is that contrast material penetrates the cord directly and accumulates in the syrinx cavity. The existence of enlarged Virchow-Robins spaces and concomitant transneural passage of fluid in some cases of noncommunicating syringomyelia are known [15], and supports the notion of a similar passage of metrizamide.

In the cases of syrinx associated with spinal cord tumor however, it has been assumed that filling of these cavities could not occur [5] because of the high protein concentrations in the cyst fluid. All of our six cases of syrinx with tumor showed opacification of the syrinx on delayed metrizamide CT scan, including cases 1 and 2, which had 2 g protein or more measured in the cavities. The patient with posterior fossa tumor (case 3) may have a form of communicating syringomyelia similar to the syrinx with Chiari malformation, despite the lack of abnormality at the obex noted at surgery. But the opacification of the syrinx cavity in the other cases cannot be explained by the Gardner theory of obex abnormality [3]. The obstructing tumor mass was located above the syrinx cavity (cases 1 and 2), yet the syrinx cavity filled with contrast material, as shown on the delayed CT study. This finding suggests that metrizamide can pass through the cord substance and favors the theory of transneural passage of fluid as an etiology for syringomyelia [2].

To delineate the exact extent of both tumor and syrinx, a cyst puncture and syringogram can be useful before surgery. A high protein content in the fluid from the cavity strongly suggests the presence of a tumor (cases 1, and 2) [7].

A spinal angiogram was obtained only in one of our cases (case 5). This showed a discrepancy between the tiny size of the tumor staining on the angiogram and the large size of the cord seen on the myelogram (this case originally did not have a delayed CT scan). Quencer [16] proposed the use of a spinal angiogram before needle aspiration of a cord lesion to find out if it is vascular or not [16]. That appears to be a more risky venture than the approach used in our cases. In those cases where some areas of myelographic cord enlargement are not shown to be due to a syrinx on delayed CT, we recommend syrinx puncture to evaluate for the possibility of tumor associated with the cavity. The needle can be safely placed into the cavity at a level known to be cystic from the CT scan, avoiding the risk of puncturing a vascular tumor. This obviates spinal angiography before cord puncture. The syrinx puncture can also provide additional data supporting the suspicion of a spinal cord tumor, that is, a high protein level in the cyst fluid and an irregular or nodular contour of the cyst wall after contrast injection.

The association of tumor with syrinx is not uncommon, and the coexistence of the two conditions may be recog-

nized by a combination of proper examination and interpretation. The delayed metrizamide CT scan was useful in the examination of this special group of syringomyelia patients. Because of the ability of metrizamide to enter the cavities in these cases of tumor, caution is necessary whenever a syrinx cavity is demonstrated on delayed CT so as not to miss possible associated tumor. In cases of suspected syringomyelia, it is insufficient merely to conclude that a cavity is present. The presence of the cavity must be verified at every level of cord enlargement in a systematic manner in order to avoid missing associated tumor.

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