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# Radiography of Posttraumatic Syringomyelia

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**Posttraumatic syringomyelia was studied in 15 patients. Gas myelography in 12 patients showed a definite spinal cord swelling in 10 and a probable cord enlargement in two. Plain spinal computed tomography (CT) in four patients demonstrated intramedullary radiolucent zones in three. After intrathecal injection of metrizamide in 10 patients, cysts were opacified in eight. Postoperative CT in two patients demonstrated collapse of the cyst in one. Gas myelography shows the extent and site of maximal dilatation of the cyst where a shunt can be placed. CT is less invasive and provides a definitive diagnosis.**

Ascending cystic degeneration of the spinal cord is a delayed and rare complication of spinal cord injury [1, 2]. Various radiologic techniques have been used to confirm the diagnosis and to locate the cyst before surgical treatment; these include gas and oil myelography [3–5], cyst puncture and endomyelography [6], and, more recently, computed tomography (CT) of the spine with or without intrathecal metrizamide [7–10]. Before the introduction of spinal CT, patients with clinically suspected cystic myelopathy in our spinal cord injury center were studied with gas myelography. The purpose of this report is to show that these two procedures complement each other in the evaluation of posttraumatic syringomyelia.

## Materials and Methods

Clinically identified posttraumatic cervical syringomyelia was studied by gas myelography and/or spinal CT in 15 patients, with operative confirmation in eight, during a 7 year period. Twelve patients underwent gas myelography and 10 underwent spinal CT. The initial spinal cord injury was located in the cervical region in 10 patients, the thoracic region in four, and the lumbar region in one. The interval between the trauma and the onset of symptoms or signs was 1–23 years (mean, 7.5 years), and patients were 22–62 years of age (mean, 43 years) when the clinical diagnosis of posttraumatic syringomyelia was made.

Gas myelography was performed under general anesthesia. The patient was placed in the right lateral decubitus position on the polytome table, tilted 12°–15° head-down. After removal of about 80 ml of spinal fluid, 60–100 ml of oxygen was introduced into the spinal canal via a C1–C2 puncture to fill the entire subarachnoid space. Lateral tomograms of the cervical, dorsal, and lumbar regions were made; slices were obtained at 2 mm intervals. Filming was repeated in the head-flat position in 10 patients and in the 5°–15° head-up position in two. At the end of the procedure, the patient was rolled into the horizontal supine position and remained in bed in a slightly head-down position for 24 hr. Gas myelography was repeated in two patients after surgical decompression of the syrinx.

CT of the cervical and upper thoracic spine was performed in eight patients on a Siemens Somatom II high-resolution scanner; two other patients were examined with a fourth-generation Delta 2010 scanner. Plain spinal CT was performed in only four patients. All 10 patients were examined immediately or within 24 hr after C1–C2 injection of 4–8 ml of metrizamide (160–200 mg I/ml), except one patient who had a lumbar puncture; seven patients were scanned twice and three were scanned three times. Slice thickness was 2–4 mm. Scanning was performed in all 10 patients in the supine position and in one patient also in the left lateral decubitus position. Two patients were restudied after shunt placement. The presence of a low-attenuation area within the cord on plain CT, or a high-density zone with intrathecal metrizamide in two or more consecutive scan slices in the absence of surrounding artifacts, was considered evidence of cyst formation within the spinal cord. A cursor was used in four patients to measure and compare the densities (in Hounsfield units) in the subarachnoid space, spinal cord, and intramedullary cyst before and/or after injection of the contrast medium.

## Results

Gas myelography showed generalized enlargement of the cervical cord in 10 patients with extension into the thoracic region in two (table 1). In two other patients, gas myelography suggested a localized swelling of the cervical cord at the site of the original fracture (fig. 1). The spinal cord enlargement or swelling was greater in the head-flat than in the head-down position in three

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patients (cases 1, 2, and 11). The cord swelling disappeared in the head-down position in case 10 (fig. 2) and in the head-up position in case 4 (fig. 3). In three other patients (cases 3, 5, and 7) modification of the position did not result in a change in the cord swelling. Postoperative gas myelography in the two patients showed a collapse of the cystic cord, which appeared atrophic.

Plain spinal CT showed radiolucent areas in the spinal cord at C6 (case 2), at C1 (case 3), and at C2–C3 and C6–C7 (case 13) (fig. 4A). After intrathecal injection of metrizamide, the cervical cord appeared enlarged in three patients (fig. 4B) and normal or small in seven. Enhancement of the cyst up to 8 hr postmetrizamide was seen in eight patients, but was absent in two. Of the three patients with an enlarged cord, one showed no evidence of cystic degeneration of the cord (fig. 5). Four patients who were scanned 24 hr postmetrizamide did not present any sign of dye uptake in the cord substance. In cases 2 and 7, the cyst which could not be seen in the first 30 min postmetrizamide was opacified 6–8 hr later. In cases 13 and 15, visualization of the cavity was better at 6 hr than 1–2 hr postmetrizamide (fig. 6). In case 13, scanning in the left lateral decubitus position resulted in increased swelling of the dependent segment of the cervical cord (fig. 4B). Postoperative metrizamide CT in two patients revealed stasis of the dye within the cyst; in one patient it showed a decrease in size of the syrinx. The upper level of the lesion demonstrated by gas myelography corresponded with that shown by CT in four patients; this correlation was not observed in two other patients (table 1).

TABLE 1: **Preoperative Gas Myelography and Spinal CT in Posttraumatic Syringomyelia ($n$ = 15)**

| Case No. | Level of Spinal Cord Enlargement on Gas Myelography | Spinal CT | |
|---|---|---|---|
| | | Level of Radiolucent Zone(s) on Plain Scan | Level of Cyst Enhancement with Metrizamide |
| 1 | C5 | ... | C5–C7 |
| 2 | C4–C5 | C6 | C1 |
| 3 | C7 | C1 | C1 |
| 4 | C5–T9 | ... | ... |
| 5 | C4–C6 | ... | Negative |
| 6 | C2–C4 | ... | ... |
| 7 | C3–C4 | ... | C4 |
| 8 | ... | ... | C4–C5 |
| 9 | ... | ... | Negative |
| 10 | C2–C7 | ... | ... |
| 11 | C5 | Negative | C4–C5 |
| 12 | C2–C5 | ... | ... |
| 13 | C3–C5 | C2–C3 and C6–C7 | C3–C7 |
| 14 | C4–T4 | ... | ... |
| 15 | ... | ... | C3–C4 |

## Discussion

Oil myelography is widely used, but it may fail to reveal a spinal cord cyst [9]. Gas myelography, first used in this country in 1919 [11], has several advantages over oil myelography in the evaluation of syringomyelia [12]. The entire spinal cord can be visualized on the lateral projection, permitting an accurate determination of the extent of the lesion [5, 12]. Variations in the size of the lesion with slight changes in the position of the patient permit differentiation of an intramedullary cyst from a solid tumor [3, 4, 13], except when the cyst is very small or dense (cases 5 and 7). When the spinal fluid is replaced with oxygen, the hydrostatic pressure in the spinal canal is decreased so that the cystic fluid moves with changes in position of the head [4, 13]; there is collapse of the elevated segment and distention of the dependent segment of the spinal cord [6], that is, collapse of the cystic cervical cord in the head-up position [12, 14, 15] (fig. 3). Collapse of the cord in the head-down position (case 10; fig. 2) has not been described previously; this finding suggests a communication between the cyst and the fourth ventricle, which is only rarely seen in posttraumatic syringomyelia

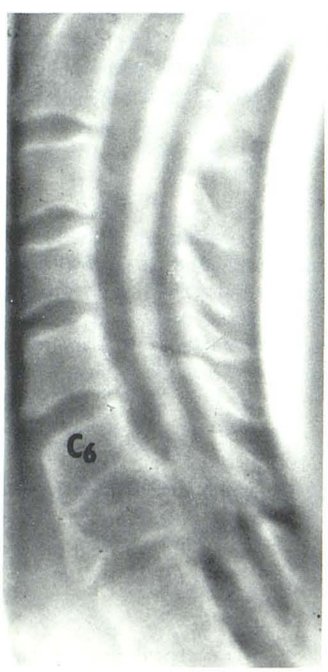


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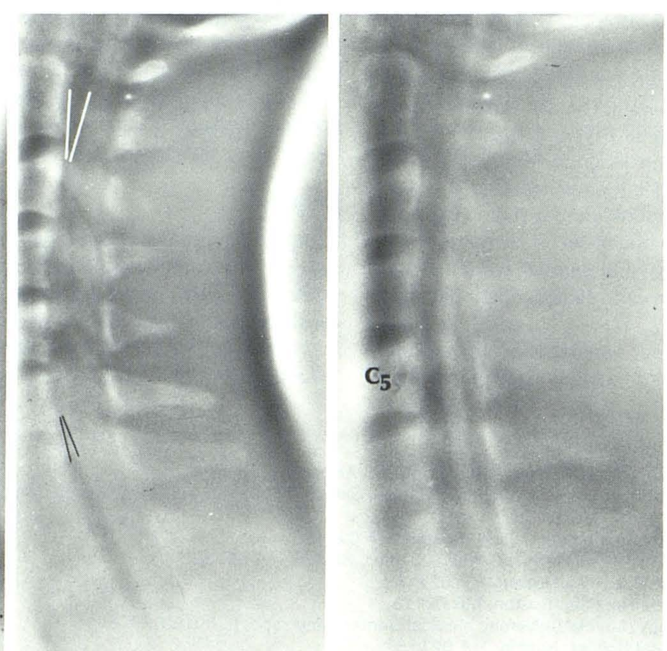
Fig. 1.—Case 3. Gas myelogram. Localized swelling of spinal cord at site of earlier C7 fracture.



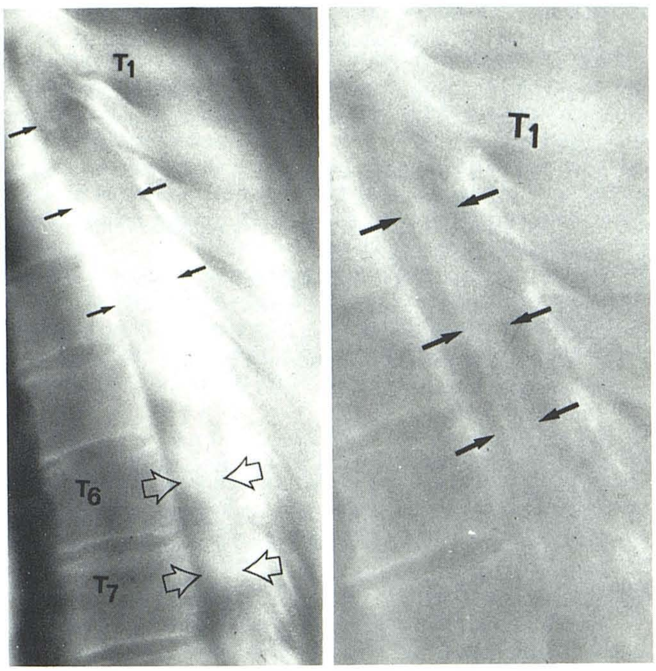

2A 2B

Fig. 2.—Case 10. Gas myelograms at midcut. **A,** Enlargement of spinal cord from C3 to C7 (*between white and black indicators*) after patient had been in head-down position (15°) about 10 min. **B,** Collapse of spinal cord after patient had been in head-down position (15°) 2 hr.

[16]. When the spinal cord swelling is in the vicinity of an old spinal fracture, it is difficult to differentiate a dilated cord from arachnoidal adhesions (fig. 1).

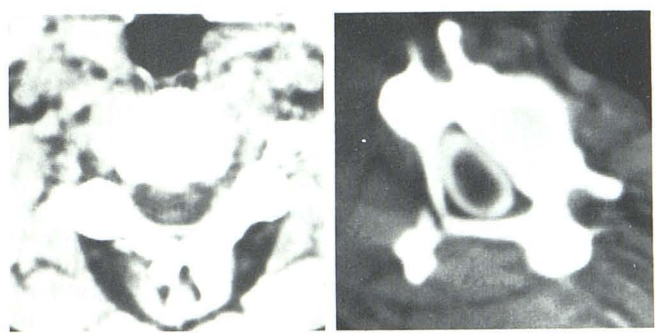
Several features of syringomyelia can be identified on spinal CT. It appears as an intramedullary high-attenuation area on plain CT (fig. 4A), especially with a high-resolution scanner [7, 9]. After intrathecal injection of metrizamide, the size of the spinal cord may appear either normal or enlarged [9]. As in the findings of Seibert et al. [17], in our series the size of the cord often (in seven of 10 cases) appeared small on CT, although gas myelography demonstrated that it was enlarged; the replacement of spinal fluid by oxygen in the vertebral canal allows the syrinx to expand [4, 13]. In cases 2 and 7, the cavity which was not detected in the first 30 min postmetrizamide was enhanced 6–8 hr later; this observation recalls the findings of Aubin et al. [8]. In cases 13 and 15, visualization of the cyst was better at 6 hr than 1–2 hr postmetrizamide (fig. 6); Aubin et al. [8] indicated that, as the CT density of spinal fluid decreases over time (up to 8 hr), there is a corresponding increase in cystic density. However, in four of our patients, the cyst was not opacified at 24 hr postmetrizamide, in contrast to the experiences of Aubin et al. [8], Bonafé et al. [10], and Arii et al. [18] in patients with nontraumatic and frequently communicating syringomyelia. This discrepancy can probably be explained by the differences in pathogenesis and in spinal fluid circulation in these two types of syringomyelia. Resjö et al. [19] noted a slight increase in the sagittal diameter of the dependent portion of the spinal cord in one patient, a finding similar to ours (case 13; fig. 4B); variations in the size of the syrinx with changes in position have been demonstrated by two-stage gas myelography [4, 13].

Gas myelography in posttraumatic syringomyelia provides some information that cannot be obtained with CT alone. It reveals the extent of the cystic enlargement and the site of maximal dilatation of the cord where a shunt can be inserted for drainage. In most CT scanners in current use, the vertebral level of the cavity may be difficult to localize accurately. Our experience with reconstruction using the Siemens Somatom II scanner has demonstrated inade-




A B

Fig. 3.—Case 4. Gas myelograms at midcut. **A,** Enlargement of spinal cord from T1 to T3 (*solid arrows*) and relatively small cord at T6 and T7 (*open arrows*) after patient had been in head-down position (15°) about 10 min. **B,** Collapse of spinal cord from T1 to T3 (*arrows*) and enlargement of cord at T6 and T7 (*not shown*) after patient had been in head-up position (5°) about 10 min.



A B

Fig. 4.—Case 13. **A,** Plain CT at C2–C3 level. Radiolucent zones within the spinal cord. **B,** Contrast-enhanced spinal CT in left lateral decubitus position, 1–2 hr postmetrizamide. Slight increase in size of dependent part of cyst at C5.

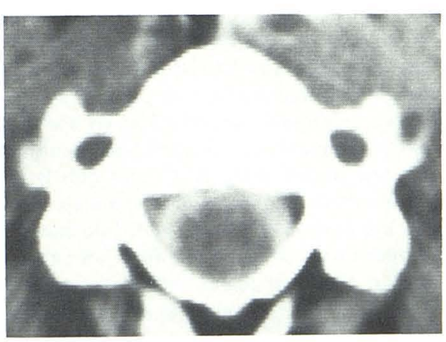


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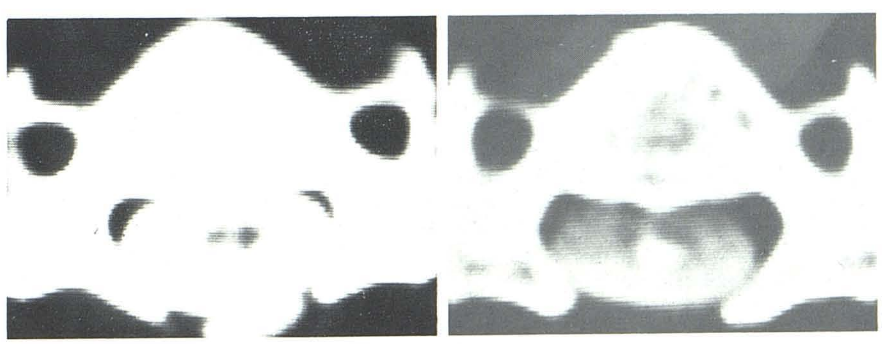
Fig. 5.—Case 9. Contrast-enhanced spinal CT at C3 level, 5 hr postmetrizamide. Enlargement of spinal cord without opacification of the syrinx.



A B

Fig. 6.—Case 15. Contrast-enhanced spinal CT at C3–C4 level. **A,** 2 hr postmetrizamide. Some enhancement of syrinx. **B,** 6 hr postmetrizamide. Increased enhancement of syrinx.

quate definition of the length of the syrinx. Moreover, changes in size of the cord concomitant with changes of the patient's position, as revealed by gas myelography, cannot be shown by CT because the imaging table cannot be tilted. Since CT can be performed without general anesthesia, it has preceded gas myelography in the investigation of all our patients with clinically suspected posttraumatic syringomyelia. However, if CT reveals a cyst and the patient shows motor deterioration or if CT is negative, the patient then undergoes gas myelography to confirm the diagnosis and to outline the length of the syrinx. If CT is positive but the patient demonstrates only sensory deterioration, he is merely monitored by frequent neurologic examinations.

CT has been used in the postoperative management of our patients, as suggested by Schneider [20]; it can follow the size of the cyst and determine the position of the shunt. Finally, although tumor of the spinal cord has been encountered very rarely in our spinal cord injured patients, gas myelography cannot differentiate cystic myelopathy from a cystic tumor. Tumor cysts on plain CT appear as low-density zones in isodense swellings, which rarely become opacified after intrathecal injection of metrizamide [21].

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