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Metrizamide Myelography and Postmyelographic Computed Tomography: Comparative Adequacy in the Cervical Spine

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Metrizamide myelography and postmyelographic computed tomography (CT) were evaluated for relative efficacy when correlated with operative findings in a series of 30 patients. Fifty-seven levels were operated on in the 30 patients with 27 patients diagnosed as having diffuse cervical stenosis, hyperostotic spondylosis, or herniated nucleus pulposus. Metrizamide myelography and CT metrizamide myelography were equally useful in providing preoperative diagnostic information at 44 of 57 levels. Both radiographic techniques agreed with the degree of canal and neural forman stenosis found operatively at more than 80% of levels. This study indicates that either metrizamide myelography or CT myelography alone is sufficient, and that both should be performed only if one fails to answer the clinical question or if syringomyelia or cord tumors are suspected.

Plain-film metrizamide myelography and metrizamide computed tomography (CT) have both become well accepted techniques in the evaluation of cervical spine disease [1, 2]. Our study was performed to determine the relative efficacy of these two methods when correlated with operative findings. The merits of each technique are discussed.

Materials and Methods

Thirty patients are included in the study, all having undergone cervical metrizamide myelography, postmyelographic CT, and cervical spine surgery. This includes all patients for whom both radiographic studies and operative results were available during the last 18 months. The 30 patients were 21 men and nine women with an age range of 22–76 years (mean age, 53.2 years). Clinical presentation was myelopathy in 12 patients, radiculopathy in 13 patients, and combined myelopathy and radiculopathy in five patients. The indication for surgery in each case involved a radiographic finding that explained the myelopathy or radiculopathy.

Myelography was performed prone via a lateral C1–C2 puncture with injection of 10–12 ml of metrizamide at a concentration of 230 mg I/ml. This was followed in 3–4 hr by postmyelographic CT. CT was performed supine on a General Electric CT/T 8800 scanner with 5-mm-thick sections at 3 or 4 mm intervals using dynamic scanning and Target Review. Sagittal reformations were generated in most cases.

Radiographic findings were correlated with operative results as to the degree of stenosis of the spinal canal and the degree of stenosis of the neural foramina. To correlate radiographic and operative findings, we defined canal stenosis in a broad sense to include any cause of focal or diffuse narrowing or compromise of the spinal canal contents. Canal stenosis was graded absent, mild, moderate, and severe. Mild stenosis was defined radiographically as partial effacement of the anterior or posterior subarachnoid space. Moderate stenosis was based on effacement of most or all of the subarachnoid space without cord flattening or displacement. Severe stenosis was considered to be present when the cord appeared flattened or displaced.

Canal stenosis was operatively classified as mild, moderate, or severe from review of the operative notes and discussion with the operating surgeon. Classification was based on

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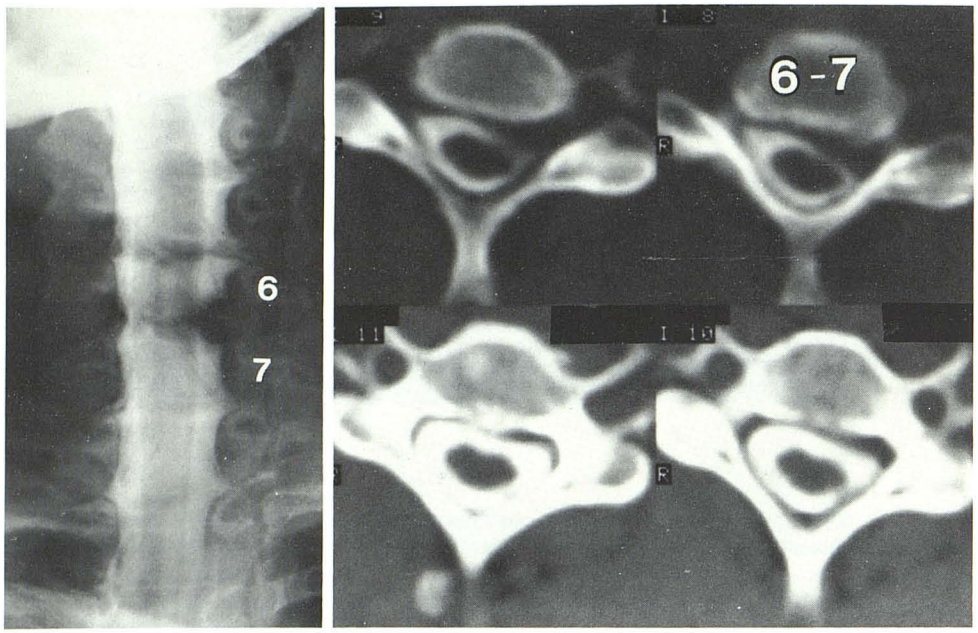


A B

Fig. 1.—Left C6–C7 HNP. Both myelography (**A**) and CT metrizamide myelography (**B**) readily demonstrate left-sided HNP at C6–C7.

findings of direct visualization of the dura and spinal cord with presence or absence of dural bulging, palpation of the anterior or posterior epidural space, paucity of epidural fat, and direct visualization of a spondylotic bar or herniated disk (anterior approach). Neural foraminal stenosis was similarly classified from palpation of the foramen with microinstruments and direct visualization of the medial part of the foramen when possible. The etiologies of stenosis were diffuse osseous canal compromise from congenital and acquired narrowing; focal hyperostotic spondylosis; tonsillar ectopia; and compromise of the canal due to soft-tissue structures including herniated nucleus pulposus (HNP), ligamentum flavum, epidural hematoma, and epidural infection. Measurements of the normal cervical cord on CT metrizamide myelography have been described by Thijssen et al. [3] and Skalpe and Sortland [4]. We did not measure the cord diameter routinely. CT metrizamide myelograms and metrizamide myelograms were evaluated separately and then correlated with operative findings. The authors reviewed each study jointly. When initial disagreement was present, the cases were discussed and a consensus reached.

Results

Fifty-seven cervical levels were operated on in the 30 patients. An anterior diskectomy was performed in 14 patients, a posterior laminectomy with or without facetectomy was performed in 15 patients, and one patient underwent suboccipital decompression. Operative diagnoses were diffuse cervical stenosis (10 patients); hyperostotic spondylosis (10); herniated nucleus pulposus (seven); and tonsillar ectopia, staphylococcal osteomyelitis and diskitis, and diffuse epidural hematoma (one patient each).

Spinal Canal Stenosis

The spinal canal was found at operation to be severely stenosed at 44 of 53 levels and moderately stenosed at nine of 53 levels. Plain-film myelography agreed with operative findings as to the degree of stenosis in 47 (83%) of 53 levels. An example of focal canal compromise where both methods agreed is shown in figure 1. Although metrizamide myelography and CT myelography agreed with surgical results as to the degree of stenosis in 88% and 83% of levels, respectively, complete accord as to the precise etiology of the stenosis was possible in less than 50%. This usually occurred with the posterior approach because visualization of anterior structures was limited and with an anterior approach because posterior visualization was restricted.

Myelography underestimated the degree of canal stenosis in six of 53 levels. The reason for the underestimation could not be determined at four of the six levels because the surgeons did not clearly specify the cause of stenosis. Two of six levels were operated on posteriorly with a lack of visualization of the anterior anatomy in both and surgical but not myelographic description of laminar hypertrophy in one.

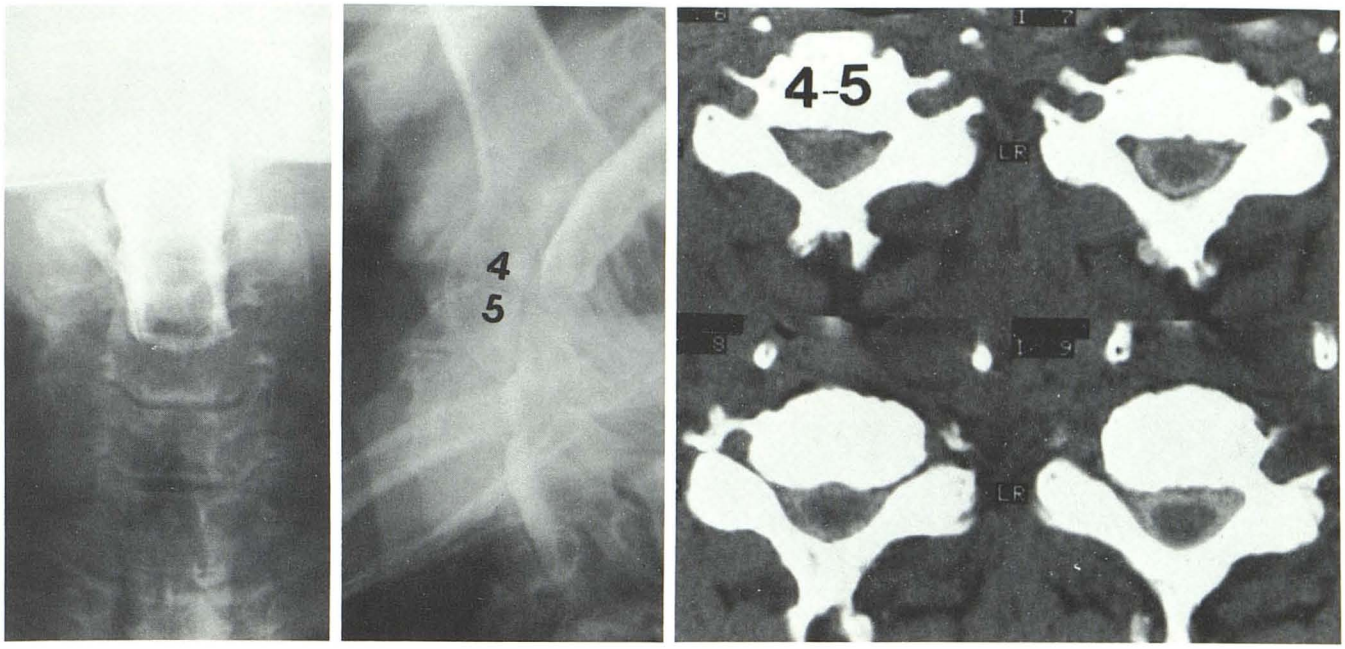
CT myelography underestimated the degree of canal stenosis in nine of 53 levels. An example of this is demonstrated in figure 2, where myelography shows severe stenosis and CT myelography, moderate stenosis. At four of nine levels the etiology of stenosis was not specified surgically. Three of nine levels had laminar hypertrophy described surgically but not radiographically. At no level was the degree of canal stenosis overestimated by myelography or CT myelography.

Neural Foraminal Stenosis

Plain-film metrizamide myelography agreed with surgical findings of degree of neural foraminal stenosis in nine of 10 levels. Postmyelographic CT agreed in eight of 10 levels.

Diagnostic Study Preferred

Metrizamide myelography and CT myelography were also evaluated subjectively as to which diagnostic examination



A B C

Fig. 2.—Diffuse severe cervical stenosis. **A**, Initial anteroposterior myelographic film shows complete block at C4–C5. **B**, Lateral view after elevation to standing position shows severe cervical stenosis greatest at C4–C5 and C5–C6. **C**, CT metrizamide myelogram shows only moderate effacement of anterior subarachnoid space.

provided the information most useful to the operating surgeon. Metrizamide myelography and CT metrizamide myelography were believed to be equally useful for 44 of 57 levels. CT myelography was preferred to metrizamide myelography at seven of 57 levels, and metrizamide myelography was preferred at six of 57 levels.

Discussion

Plain-film myelography has been the time-honored radiologic method for evaluation of cervical spine pathology. Metrizamide and newer water-soluble agents [5] have replaced Pantopaque as the contrast medium of choice. CT metrizamide myelography has become an important adjunct to plain-film myelography [6–8] since first reported by Di Chiro and Schellinger [9], but its role still awaits precise definition.

In a series of 106 patients reported by Dublin et al. [8] undergoing both plain-film metrizamide myelography and CT myelography, 41 were studied at the cervical level. They found CT myelography and metrizamide myelography to be comparable in 57% with CT myelography superior in 40% of patients when considering lumbar, thoracic, and cervical levels together. The cervical results were not reported separately. Although the clinical diagnoses in that series were similar to ours, it is not clear what percentage of their patients had operative correlation.

In 54 of 99 patients with metrizamide myelography and CT metrizamide myelogrpahy reported by Post [2], plain-film myelography was considered important for diagnostic accuracy, but the reasons were not enumerated. Cervical results were not reported separately from the thoracic and lumbar studies.

We found both studies to be equally useful for preoperative assessment at 44 of 57 levels in our 30 patients. Both techniques agreed with the degree of canal and neural foraminal stenosis found operatively at more than 80% of levels. Initially we attempted to correlate the radiographic and surgical findings to the etiology of stenosis. However, this was often not possible due to limitations of the operative field of view. These limitations in operative visualization have been described by Raynor [10].

Skalpe and Sortland [4] found good correlation in the sagittal diameter of the cervical cord between CT metrizamide myelography and metrizamide myelography, with CT myelography having lower mean values by 1 mm. We were interested to find several cases in which the subarachnoid space was completely effaced anteriorly and posteriorly on myelography but appeared only moderately effaced with CT metrizamide myelography. We believe this is explained by maximizing of the stenosis with myelographic positioning in prone extension and a minimizing of the stenosis with CT metrizamide myelography positioning in supine flexion. This is illustrated in figures 2 and 3. Supine CT metrizamide myelography usually failed to demonstrate ligamentum flavum hypertrophy, which was well seen myelographically and surgically. We are in the process of evaluating CT myelography performed prone.

An advantage of myelography is that it readily visualizes the entire length of the cervical canal from the foramen magnum to the thoracic junction, often demonstrating significant pathology at levels other than those suspected clinically. An example is shown in figure 4, where CT graphically illustrates the relation of the posterior epidural hematoma to the cord, but where myelography readily imaged the full extension of pathologic levels. In our study CT metrizamide myelography

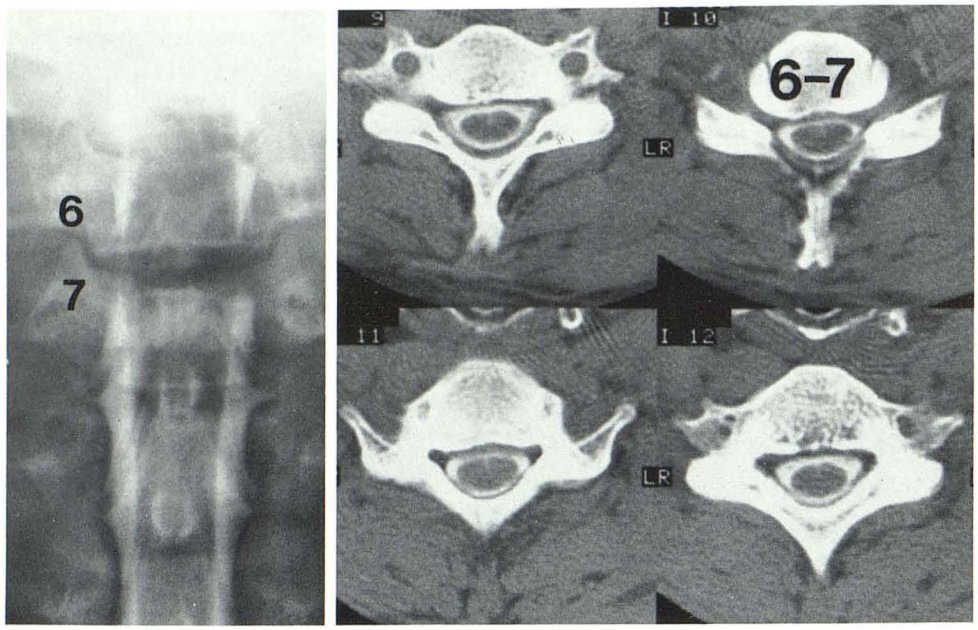


Fig. 3.—C6–C7 HNP. **A**, Metrizamide myelogram shows bar defect at C6–C7 with amputation of nerve root sleeves bilaterally. **B**, Supine CT metrizamide myelogram underestimates findings.

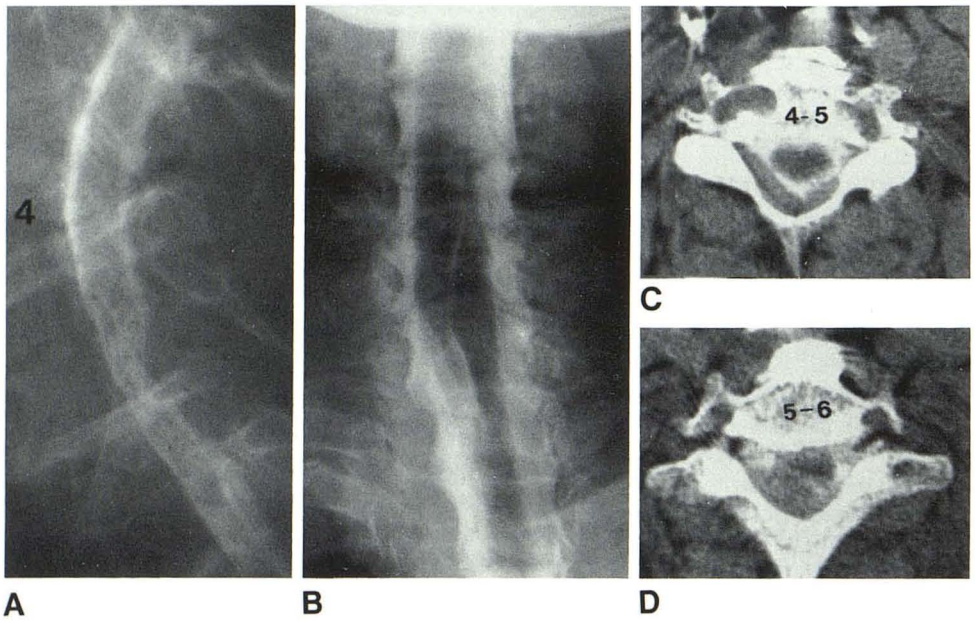
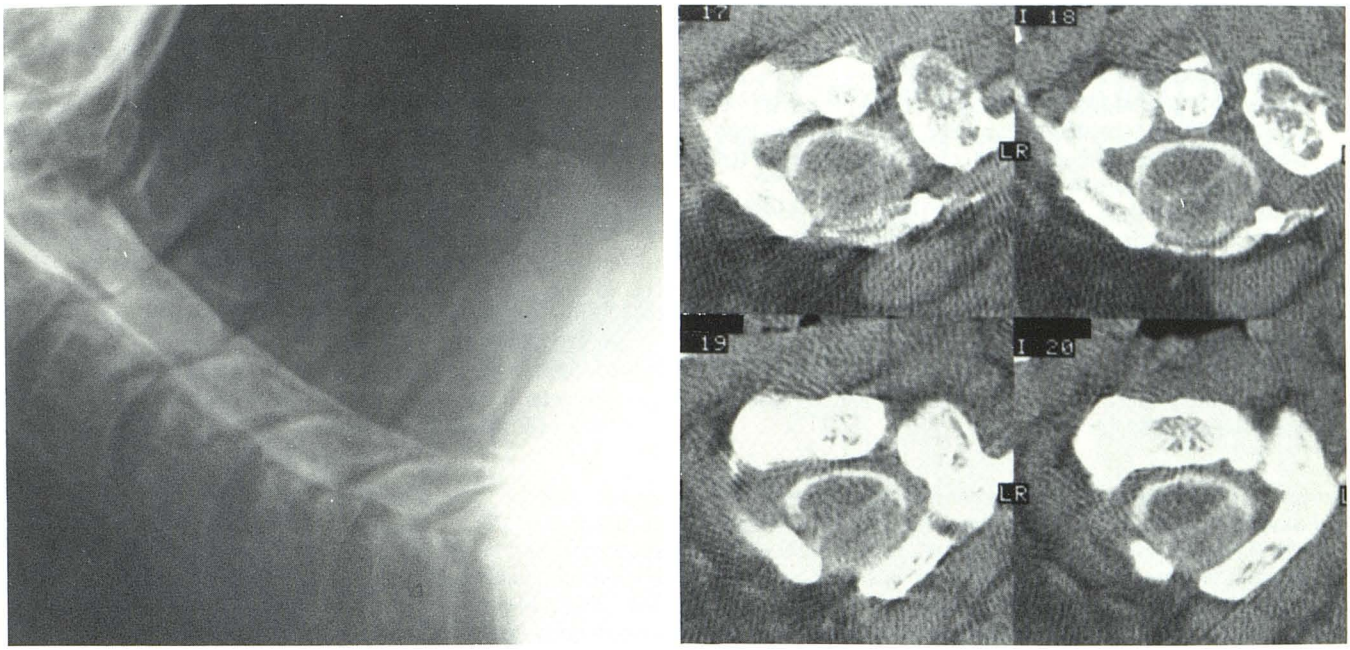


Fig. 4.—Epidural hematoma. **A**, Posterior extradural mass is shown myelographically to extend inferiorly from C4 level. **B**, Linear contrast density overlying cord shadow represents displaced posterior subarachnoid space. **C** and **D**, CT metrizamide myelograms delineate relation of hematoma to cord more clearly.

was performed after metrizamide myelography, but if CT myelography is performed alone, scans should be obtained at all cervical levels including the foramen magnum. Figure 5 is an example of tonsillar ectopia that was not initially suspected clinically.

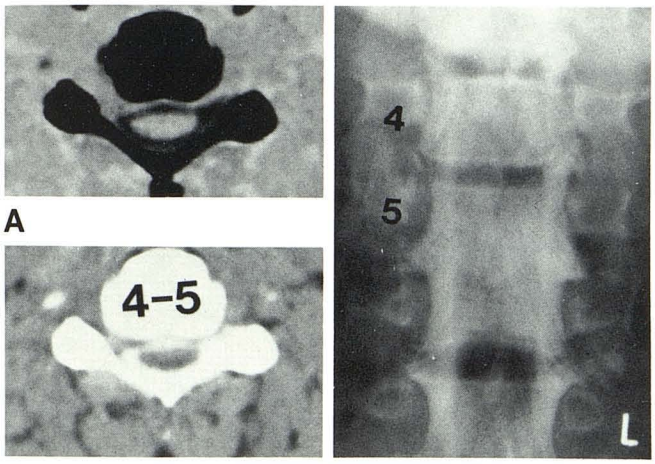
An advantage of CT metrizamide myelography without metrizamide myelography is that it can be performed on an outpatient basis with a low dose of contrast material administered via a lumbar puncture, thus reducing cost and morbidity. In addition, CT metrizamide myelography more easily differentiates between soft disk and osteophyte. However, the choice of operative approach is based more often on the degree of canal and foraminal stenosis and the number of levels involved than on the exact etiology of stenosis.

Coin and Coin [11] and Glenn and Rothman [12] reported consistent visualization of cervical disks on CT without the



A B

Fig. 5.—Tonsillar ectopia. **A**, Metrizamide myelogram reveals posterior foramen magnum mass. **B**, CT metrizamide myelogram identifies etiology as tonsillar ectopia.



A B C

Fig. 6.—Right C4–C5 HNP. **A** and **B**, CT metrizamide myelograms demonstrate right C4–C5 HNP. **C**, Only minimal asymmetry of right C4–C5 nerve root sleeve is seen on myelography.

use of contrast material. This has not been our experience. However, these authors used 1.5 mm sections often limited to the lower four cervical levels [12]. They did not examine the entire cervical spine with this technique routinely, so significant lesions at higher levels may have been missed.

Our results illustrate the complementary nature of metrizamide myelography and CT metrizamide myelography, but suggest that either study alone is sufficient in more than 80% of patients. Both studies should be performed when one method alone fails to define the etiology of a cervical radiculopathy or myelopathy. (This is illustrated by figure 6.) Metrizamide myelography followed by CT metrizamide myelography has been recommended for all patients with suspected syringomyelia or cord tumors, with plain-film myelography localizing the extent of the lesion and CT metrizamide myelography defining its nature [13–15]. We concur with that recommendation.

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