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Plain and Metrizamide CT of Lumbar Disk Disease: Comparison with Myelography

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Computed tomography with and without administration of intrathecal contrast material was evaluated in 100 patients with suspected lumbar disk disease. Metrizamide computed tomography was performed in 75 patients and plain computed tomography was performed in 25. Metrizamide computed tomography was more accurate than plain computed tomography. It also disclosed many lesions not shown by metrizamide myelography at the lumbosacral level. Very few lesions were revealed by myelography that were not seen by metrizamide computed tomography. The small amount of intrathecal metrizamide needed for scanning has practically no side effects. Experience in 12 patients indicates that the procedure may be performed safely on an outpatient basis. This study suggests that computed tomography should be given serious consideration as the primary definitive radiographic examination of suspected lumbar disk disease.

Myelography fails to demonstrate 15% of disk herniations at the lumbosacral level and 5% at L4-L5 [1-3]. Other methods such as diskography, epidurography, and venography are not used routinely because they cause physical discomfort and are often inconclusive [1, 4]. Computed tomographic (CT) scanning is noninvasive, but should be compared with myelography before its accuracy can be determined. We compared metrizamide myelography and CT, both without and with intrathecal metrizamide.

Materials and Methods

One hundred patients with suspected lumbar disk disease were studied. Plain CT was performed in 25 cases and CT after administration of intrathecal metrizamide in 75 cases. Metrizamide myelography was performed in all 100 patients. Surgical exploration was made in 53 patients.

CT was performed on the GE 8800 scanner using 400 mAs and 120 kV. Lateral ScoutView images were obtained in all patients for alignment of the sections. Sections of 1.5 and 5 mm were obtained through L3-L4, L4-L5, and L5-S1 disk spaces. Additional 5 mm sections were made in the adjacent vertebral bodies when "reformatting" was needed. Soft pillows were placed below the hips and lower thorax whenever necessary to decrease lumbar lordosis for proper alignment of the sections with a maximum gantry tilt of 15°. In those cases where, despite this maneuver, it was not possible to obtain true axial sections through the disk spaces, axial sections were "reformatted" using the GEDIS software program (G.E. experimental software) when this became available during the latter part of the study. Additional sagittal and oblique reformatted images were obtained whenever better delineation of the lesions was desired.

Metrizamide CT was performed 2-6 hr after myelography. Patients were rolled over several times before scanning to ensure thorough mixing of the contrast material. In addition, 12 patients were studied apart from myelography by introducing 1-2 ml of 170 mg I/ml metrizamide into the subarachnoid space immediately before scanning. These 12 patients were followed for 24 hr after the scanning for headaches, nausea, or other complications at regular intervals. Patients were specifically questioned about the above

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symptoms and vital signs were recorded.¹

Two sets of films were routinely made: one at soft-tissue window settings to visualize the disks and epidural spaces, and another at bone window settings for evaluation of the bony structures. ReView (G.E. software) high-resolution pictures were made for better visualization of intrathecal metrizamide, disks, and bony structures. Myelography was performed using 16 ml of 190 mg I/ml concentration of metrizamide. The contrast material was not removed but the patients' heads were kept elevated until scanning.

All the examinations were reviewed without clinical data independently by the two authors. Plain and metrizamide CT were considered positive only when one or more of the following findings were present: (1) Disk margins were visibly protruded behind the normal anterior wall of the spinal canal (fig. 1). The disks were either confined to the level of the intervertebral space or extruded to the adjacent vertebral bodies with or without calcification (figs. 1-3 and 6B). (2) There was definite compression of the dural sac or obliteration of the epidural fat by the disks (figs. 4-6). (3) There was displacement, compression, or obliteration of the nerve root sleeves (fig. 7). All equivocal findings as well as those where there was incomplete agreement between the authors were considered as

negative. The myelograms were assessed by the same strict criteria. Surgical findings were compared with the radiologic observations.

The primary aim of the study was to compare different diagnostic methods. Therefore, the cases were grouped according to CT and myelographic findings. In *group 1*, metrizamide or plain CT and myelography were both positive; in *group 2*, plain or metrizamide CT and myelography were both negative; in *group 3*, plain or metrizamide CT was positive and myelography was negative; and in *group 4*, plain or metrizamide CT was negative and myelography was positive. Findings were compared at L3-L4, L4-L5, and L5-S1. Surgical correlation to these findings was possible in 53% of cases.

Results

Our findings are shown in table 1. There was agreement between plain or metrizamide CT and metrizamide myelography in 75% of cases (groups 1 and 2). Analysis of the other cases showed that discrepancies in the findings were more common at the L5-S1 level than at the L4-L5 level (table 2, groups 3 and 4). At L3-L4, no significant difference was noted. Both plain and metrizamide CT were more accurate than myelography in demonstrating protruded disks at L5-S1 than at L4-L5 (group 3). In group 3, where metrizamide or plain CT was superior to myelography at the L4-L5 and L5-S1 levels, metrizamide was used in most cases (13 of 16).

Surgical exploration in 53 cases revealed herniated disks in three patients who had normal plain or metrizamide CT and myelography. There were no negative surgical explorations.

Of the 12 patients who had metrizamide CT using a small dose of metrizamide, one complained of mild headaches immediately after scanning. The headache in this patient improved with aspirin in 6-8 hr. No other symptoms or complications were noted in the rest of this group of patients.

Discussion

A definitive diagnosis of disk herniation is made when there is compression of the subarachnoid space and nerve

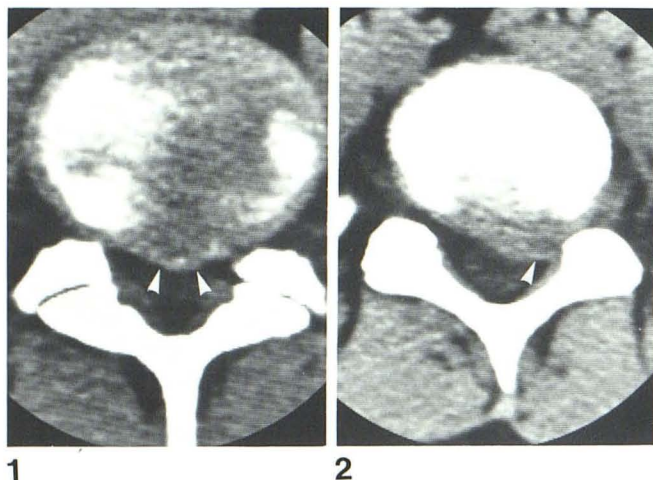


Fig. 1.—Central disk protrusion. Convex configuration of disk margin (arrowheads).

Fig. 2.—Lateral disk protrusion causes narrowing of exit foramen (arrowhead).

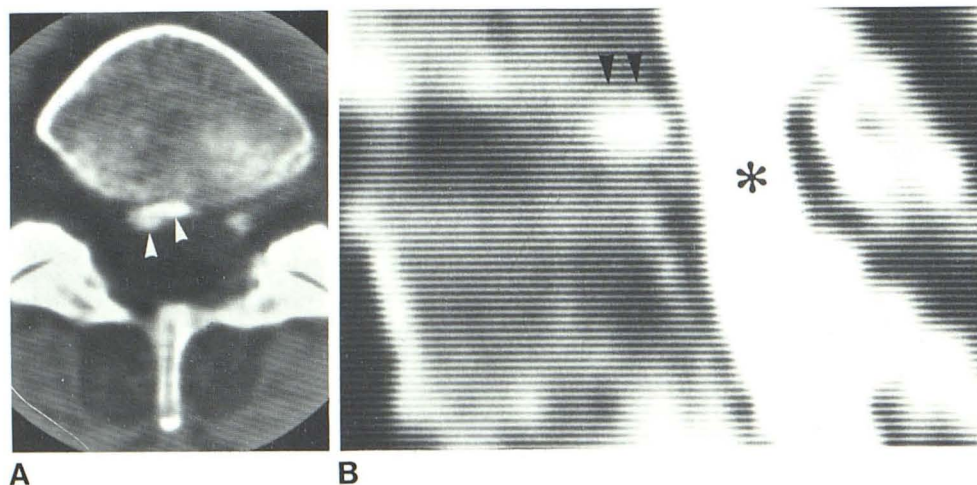
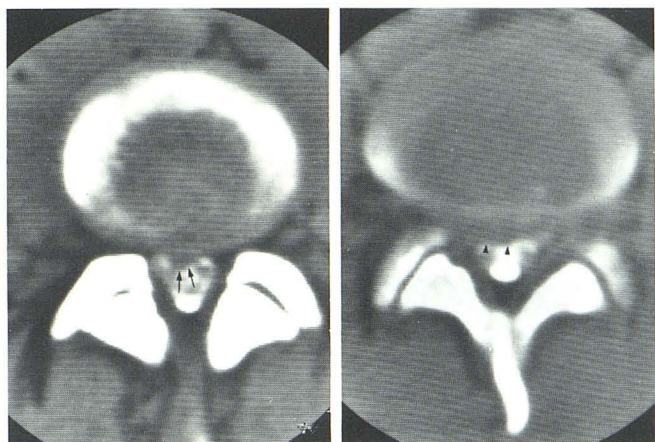


Fig. 3.—A, Calcified disk protrusion into spinal canal (arrowheads) beyond disk level. B, Sagittal reconstruction shows precise extent of subarachnoid compression (arrowheads). Metrizamide is in subarachnoid space (asterisk).

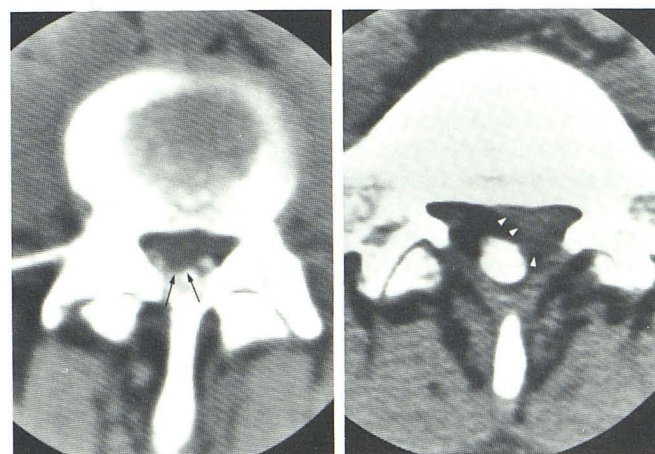


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Fig. 4.—Metrizamide CT. Central compression of subarachnoid space (arrows).

Fig. 5.—Metrizamide CT. Lateral compression of subarachnoid space (arrowheads).



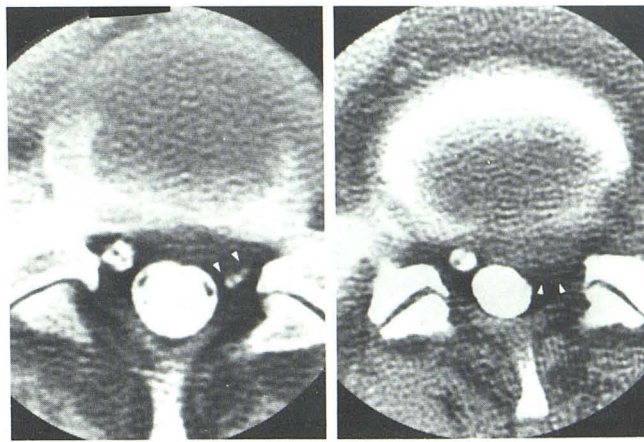
A

B

Fig. 6.—Metrizamide CT. A, almost complete compression of subarachnoid space by very large disk (arrows). B, 1 cm below. Extruded disk has extended beyond disk level to adjacent vertebral body (arrowheads).

root sleeves on CT and myelography [5–11]. Although some authors have stated that it is usually possible to distinguish disk herniations from bulges due to prominent annulus on myelography [1, 12], it becomes difficult sometimes to make this distinction on CT scans. However, diagnosis of disk herniation was made in our series only when the strict criteria described above were met. In addition, we considered the diagnosis of disk protrusion when the margins of the disks were clearly visible to be beyond the normal confines, even though direct compression of the subarachnoid space was not clearly visible on CT (fig. 1).

In our study, when CT and myelography agreed (groups 1 and 2), there was no problem in diagnosis, and either test could have been used. Of more concern were those cases



A

B

Fig. 7.—Metrizamide CT. A, Posterior displacement of S1 nerve root sleeve by herniated disk (arrowheads). B, 0.5 cm below. Incomplete filling of S1 nerve root sleeve due to disk herniation (arrowheads).

TABLE 1: Patients Grouped by Plain or Metrizamide CT and Myelographic Findings

Group No.	CT		Totals	Surgically Proven
	Metrizamide	Plain		
1, Pos CT and myelography	46	8	54	38
2, Neg CT and myelography	11	10	21	3
3, Pos CT and neg myelography	13	3	16	9
4, Neg CT and pos myelography	5	4	9	3
Totals	75	25	100	53

Note.—Pos = positive; neg = negative.

TABLE 2: Comparison of Metrizamide and Plain CT Results at Different Levels

Group No.: Study	Level		Totals
	L4–L5	L5–S1	
3, Pos CT, neg myelography:			
Metrizamide CT	4	9	13
Plain CT	1	2	3
(Surgically proven)	(2)	(7)	(9)
4, Neg CT, pos myelography:			
Metrizamide CT	3	2	5
Plain CT	2	2	4
(Surgically proven)	(1)	(2)	(3)
Totals	10	15	25

Note.—Pos = positive; neg = negative.

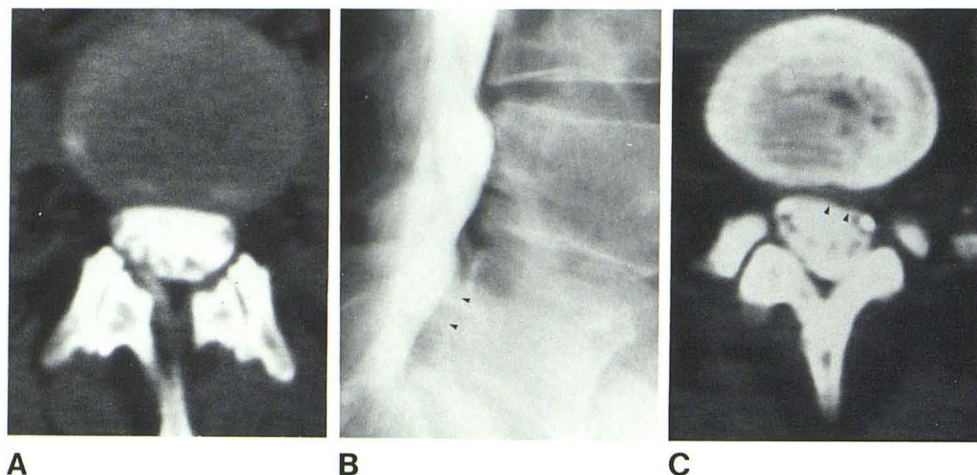


Fig. 8.—**A**, Metrizamide CT. Prominent disk at L4–L5 with no herniation. **B**, Myelogram. Widened epidural space behind vertebral body (arrowheads). **C**, After myelography at L5 vertebral body. Extruded disk fragment with compression of sac (arrowheads).

raphy (group 4). constitute a 9% false-negative rate for CT. Of these nine cases, four had plain CT studies. No density difference was appreciated between the sac and disk margins, however, myelography did show indentation of the sac. Two of the five cases with metrizamide CT were at the L5–S1 level, and the epidural soft-tissue density was considered to be due to bone averaging because of poor alignment to the disk plane. These cases were seen during the early part of the study, when the oblique reconstruction format was not available. Three other cases had extruded fragments above or below the disk level where sections were not made initially and showed no obvious abnormality at the disk level. However, slices done after the myelogram at the level of epidural defect behind the vertebral body did show disk herniation (fig. 8).

Surgical exploration in three patients with negative CT and myelography (group 2) was done on a clinical basis. They were labeled positive; however, the description of herniated disk was vague in the operative notes in these cases, and surgical findings included the presence of adhesions and fibrosis.

Apart from the imprecise documentation of pathologic findings at surgery, there were anatomic and technical factors that might explain the discrepancy between plain or metrizamide CT and myelographic findings. Compression of the subarachnoid space at the lumbar disk levels down to L4–L5 was demonstrated on myelography and on CT because of the usually close proximity of this space to the back of the vertebral bodies (fig. 3B). Such compression is often more difficult to demonstrate at the lumbosacral level, where the normal dural sac is frequently separated from the disk and vertebral bodies by a larger epidural space. Myelography at this lower level may show little or no compression of the subarachnoid space (fig. 9B), but CT may show the margin of the disk protruding into the fat-filled epidural space (fig. 9A).

The nerve root sleeves pursue an oblique course relative to the CT plane at the L3–L4 and L4–L5 levels so that subtle compressions may not be apparent. The sleeves become more vertical in their course at the lumbosacral level and are at right angles to the CT plane. Therefore, very subtle

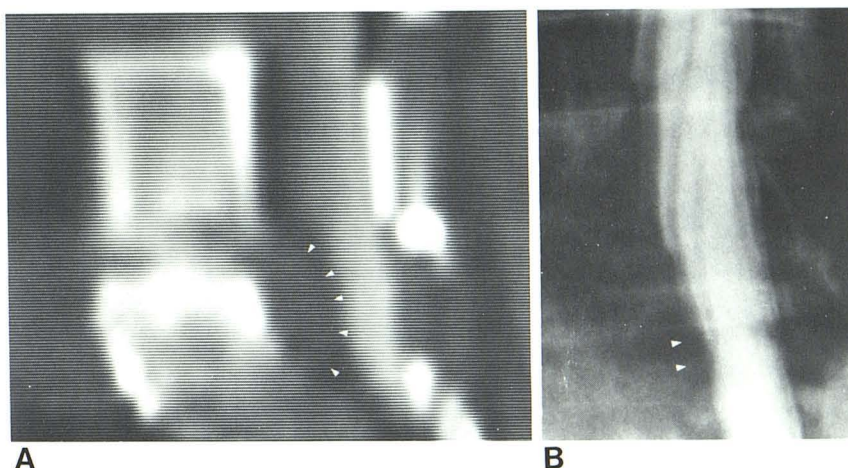
displacement or compression of the sleeves at this level is shown more easily on CT than on myelography, especially if the subarachnoid space is filled with metrizamide (figs. 6B and 7).

Resolution of CT scans may be improved by increasing the contrast difference between the subarachnoid space and nerve root sleeves and the surrounding epidural and disk spaces. This was most effectively achieved by intrathecal metrizamide, which revealed subtle distortions not visible without contrast (fig. 7A). The high concentration of iodine used for myelography created artifacts on CT scans, which may be alleviated by delaying the scans for several hours, or by using the ReView software programs (fig. 7A). A smaller quantity of contrast material (1–2 ml 170 mg/ml iodine) may be used for scanning immediately after the introduction of contrast material in the subarachnoid space and complications caused by higher concentrations can also be avoided.

High-resolution CT scanning made direct visualization of the disk protrusions possible, and it was particularly helpful at the lumbosacral level where the thick epidural space may obscure compression of the dural sac and nerve root sleeves (fig. 1). Whether such disk protrusions, which did not compress the dural sac and nerve roots, were responsible for symptoms remains unclear.

A false diagnosis of disk protrusion, especially at the lumbosacral level, may be made when the CT sections are not exactly in the plane of the disks. We used reformatted axial sections with the GEDIS software program to correct this. In our series, only nine of 16 patients in group 3 had surgical exploration. Seven patients improved on conservative treatment. Most of these cases were diagnosed at the L5–S1 level. Repeat scanning in five of these seven cases at a later date with the availability of ReView formatting showed no disk herniation. The image quality was invariably degraded by this additional maneuver. It was not as critical to align the sections as accurately with metrizamide CT as with plain CT. Alignment problems may be corrected for plain CT by using thinner 1.5 mm sections, but unfortunately this usually results in images with unacceptably high noise levels.

Fig. 9.—A, Metrizamide CT. Extremely large extruded disk on oblique format (arrowheads). B, Oblique view of myelogram. Equivocal compression of S1 nerve root sleeve (arrowheads).



Complications of metrizamide myelography are well recognized [13–15] and tend to occur several hours after myelography. The side effects are generally dose-dependent. Low doses can be used for metrizamide CT (1–2 ml 170 mg/ml iodine), which make it almost free of side effects. Mild headaches in one of our patients immediately after the procedure were most likely related to lumbar puncture rather than to contrast material in the subarachnoid space.

Radiation exposure of CT examinations (4–5 rad [0.04–0.05 Gy] skin dose per section) is considerably less than myelography [16]. In situations where plain or metrizamide CT is as accurate as myelography, there is ample justification for selecting the examination with the least side effects and radiation dosage.

Our study showed no apparent difference in the accuracy of myelography over CT. In fact, metrizamide CT seemed slightly superior in some cases (group 3). Thus, it is logical to conclude that metrizamide CT may be used interchangeably with myelography for diagnosis of disk herniations at specific disk levels. Our study also indicated that the amount of intrathecal contrast material required for metrizamide CT (1–2 ml 170 mg I/ml) was less than one-eighth of that used for myelography and was virtually free of side effects. Metrizamide CT using such low dosages would be expected to be safe for an outpatient procedure provided the patients are kept under observation for 6–8 hr after the procedure. An additional benefit of metrizamide CT is the low dosage of radiation (4–5 rad [0.04–0.05 Gy] skin dose/section) as compared with conventional myelography. We recommend the following routine for evaluation of lumbar disk disease: (1) plain CT; if disk is not defined, (2) metrizamide CT (outpatient); (3) proceed to myelography (inpatient) only if metrizamide CT does not show disk lesion.

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