AFRICAN JOURNAL OF MEDICINE and medical sciences

VOLUME 36 NUMBER 1 MARCH 2007

ISSN 1116—4077

Helical CT myelogram: *The Ibadan initial experience*

OA Ogunseyinde, GI Ogbole and YU Osuagwu
Department of Radiology, University College Hospital Ibadan, Nigeria

Summary
To evaluate our initial experience with Helical Computed Tomography (CT) Myelogram in the investigation of spinal abnormalities. As late as 1980, CT was still regarded as unreliable compared with myelography however, the advent of slip-ring technology in the 1990s, in association with the use of more powerful computers and higher energy x-ray tubes allowed a process known as Helical CT. This revolutionized CT scanning allowing achievement of thinner slices in a single breath-hold. Helical CT myelogram is one of the recent applications with the potential of improving clinical diagnosis in patients with spinal disorders. This is a descriptive study of 56 patients who had a CT myelogram in the first 15 months of operation of a helical CT scanner at Ibadan (January 2004 –March 2005). Axial scans were done after a lumbar puncture with injection of 8-10mls of contrast (iopamidol). Demographic, clinical data and CT findings were analyzed. Patient ages ranged from 3 to 75 years. The highest age frequency was seen in the 4th and 5th decade. 37 (66%) of these patients were males and 19(34%) were females. The majority of scans, 22 (39.2%) were in the thoracic and thoraco-lumbar regions. Low back pain was the most common indication 26(32.1%) followed by paraplegia 24(29.6%). Spinal cord compression and spondylosis represented 34% and 20% of the CT findings respectively. Helical CT myelogram is a valuable investigative tool which demonstrates spinal abnormalities well by providing a good silhouette image of the spinal cord.

Keywords: *Myelogram, Helical CT, Spinal abnormalities*

Résumé
Cette étude descriptive avait pour but d'évaluer l'application initiale de la tomographie informatisée hélicoïdale (TI) myélogrammes dans l'investigation avec pour potentiel d'améliorer le diagnostic clinique des anomalies épinières. Cinquante six patients qui avaient eu le TI myélogramme dans les 15 premiers mois de l'opération à Ibadan (Janvier 2004-Mars 2005).Les scanners axiaux étaient faites après la puncture lombaire avec injection de 8 à 10 ml d'iopamidol .Les données démographiques et cliniques et les résultats du TI étaient analysés. L'age des patients varie 3 à 75ans. La plus grande fréquence d'age était entre 40 et 50ans.Trente-sept (66%) étaient males et dix-neuf (34%) étaient femelles. la majorité des scanners,vingt deux (39.2%) étaient dans les régions thoraciques et thoraco-lombaire. Les courbatures étaient l'indication) le plus communs 26(32.1%) suivit de la paraplégie 24(29.6%) la compression de la moelle épinière et le spondylose représentaient 34% et 25% des résultats de TI respectivement.

Correspondence: Dr. O.A. Ogunseyinde, Department of Radiology, University College Hospital, PMB 5116, Ibadan, Nigeria. Email: roguns@comui.edu.ng.

Introduction

As late as 1980, CT was still regarded as unreliable compared with myelography, currently high-resolution CT scanning permits quite satisfactory, though still imperfect, imaging of the soft tissues of the spinal canal [1]. The advent of slip-ring technology in the 1990s,in association with use of more powerful computers and higher- energy x-ray tubes allowed the replacement of incremental slice technology with a process known as *Helical / Spiral CT*, which consists of continuous activation of the x-ray source and continuous movement of the tabletop through the gantry, resulting in volumetric acquisition. These advances have revolutionized CT scanning, allowing acquisition of thinner slices in a single breath-holding period [2]. Helical CT myelogram is one of its applications with the potential of improving clinical diagnosis in patients with spinal disorders where a Magnetic Resonance Imaging (MRI) facility, which is the gold standard [3], is unavailable. Diagnostic error in earlier studies was attributed to inexperience, lack of knowledge of normal anatomical variance, and poor resolution. Also technical progress in the last decade has rendered obsolete several radiological methods of investigating the spine, some of which have only been perfected in recent years.

Unfortunately MRI the most effective and non-invasive of the recent advances is expensive and not yet universally available in our environment. However helical CT may provide a good alternative when handled in experienced hands. Helical CT myelogram has several advantages some of which include; (i) rapid scan time; which limit artefacts due to involuntary movements including swallowing and respiration,(ii) digital radiograph-cursor line and tilting of gantry , allowing selection of the optimal scanning plane , which for most conditions is perpendicular to the long axis of the spinal canal,(iii) variable-section width, sections as thin as 2mm can be obtained reducing partial volume effect in narrow structures such as cervical disc and is necessary for high resolution reformation,(iv) reformation of acquired images in any desired plane. Other advantages include a higher degree of lesion detection and better lesion characterization with a radiation dose which is similar to or less than that used in conventional CT.

Materials and method

Between January 2004 and March 2005, 56 consecutive patients referred to Radiology Department of the University College Hospital Ibadan, who had CT myelogram (CTM) using a single-slice helical CT scanner (CT/e GE Medical systems) were reviewed.

There were 37(66%) males and 19(34%) females whose ages ranged from 3 to 75 years; mean age of patients was 42years. Their demographic clinical and imaging findings were obtained from hospital files. All patients gave a written informed consent.

Axial CT scans were done following a lumbar puncture with the injection of 8-10mls of nonionic contrast material (iopamidol 300; Bracco Diagnostics, Milan, Italy) into the subarachnoid space. All scans were preceded by a lateral scout for planning and appropriate tube angulation. The following CT parameters were used; 120-kVp maximum; 150 to 200 mA, 512 x 512 matrix, 15-cm scan field of view, 3mm collimation, Pitch of 1.5, 1.0 second gantry rotation time and a 2mm reconstruction interval.

All patients were admitted and monitored for 24hours in the supine position for possible complications and adverse reactions.

Results

During the period of study, CTM accounted for 4.7% (56/1190) of all CT procedures performed. 76% (42/56) of these were referred from surgical specialties and 24% (14/56) from medicine. 56% (33/56) of the patients were between the third and fifth decade of life (figure 1).

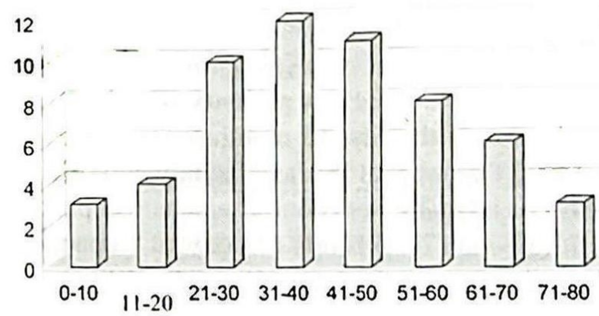


Fig. 1: Shows age distribution of 56 CTM patients

Indications for CTM included low back pain, paraplegia/paraparesis, and quadriplegia / quadriparesis (Table 1). Traumatic injury to the spine from various causes including gun shot injury (Fig.2a-c) was responsible for 30.4% (17/56) of the cases evaluated; other causes were fall from a height and road traffic accident.

Table 1: Indication for CTM

Indication	Number	Percentage (%)
Low back pain	26	32.1
Paraplegia	24	29.6
Paraparesis	10	12.4
Quadriplegia	10	12.4
Quadriparesis	7	8.6
Neck pain	4	4.9
Total	81	100

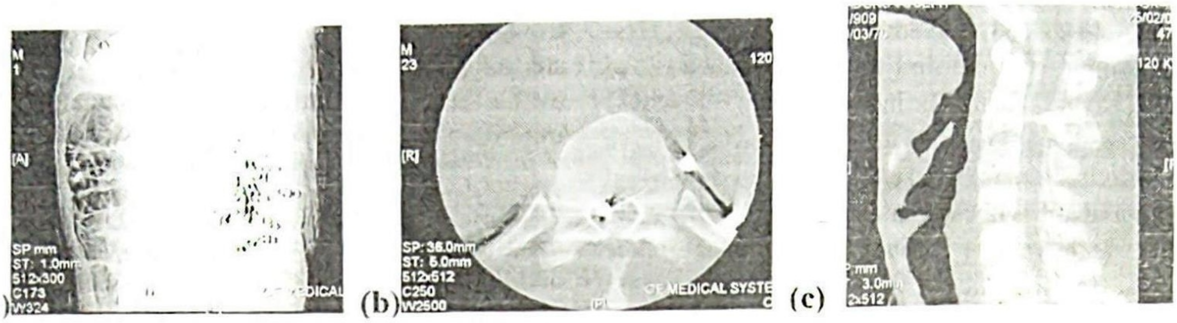


Fig. 2a-c: Gun shot injury to the spine. (a) Sagittal scanogram showing multiple metallic dense pellets over the thoracolumbar spine. (b) Axial image in the same patient showing peller within the vertebral canal of D12 extradurally with non-visualization of the theca space and cord compression. (c) Sagittal CTM image in another patient with cord compression from gun pellet in the cervical spine with posterior indentation of the cord at the level of C2.

Table 2: Regions of study

Region	Number	Percentage (%)
Cervical	10	17.9
Cervico-Thoracic	9	16.1
Thoracic	11	19.6
Thoraco-Lumbar	11	19.6
Lumbar	8	14.3
Lumbo-sacral	7	12.5
Total	56	100

Table 3: CTM findings

CTM finding	Number	Percentage (%)
Cord Compression	32	33.7
Spondylosis	19	20.0
Disc Herniation/ Prolapse	11	11.6
Vertebral Fracture	7	7.4
Tumor	6	6.3
Extradural (2) Intradural (1) Intramedullary (2) vertebral(1)		
Vertebral collapse/ destruction	5	5.3
Spondylolisthesis	5	5.3
Facet Hypertrophy	3	3.2
Normal	3	3.2
Paravertebral Abscess	1	1.0
Canal Stenosis	1	1.0
Metastatic deposit (breast & prostate)	2	2.0

The thoraco-lumbar and thoracic regions were the most studied areas accounting for 39.2% of all studies (Table 2). The scan duration ranged from 43 to 100 seconds with an average duration of 62 seconds. CTM demonstrated cord compression in 32 patients, spondylosis in 19, Disc herniation/ prolapse in 11, Vertebral Fracture in 7 and spinal tumour in 6 (Table 3).

The various causes of cord compression are listed in Table 4, with disc herniation /prolapse accounting for 27% and bony fragments and osteophytes representing 25% and 19% respectively.

Table 4: Causes of spinal cord compression

Cause	Number	Percentage (%)
Disc prolapse	11	30.6
Bony fragments	9	25.0
Osteophyte	7	19.4
Tumor	4	11.0
Gun pellet	4	11.0
Haematoma	1	3.0
Total	36	100

CTM demonstrated 6 tumours which represents 10.7% of all cases seen, (2 extradural, 2 intramedullary, 1 intradural and 1 vertebral). Three of these tumors were confirmed at surgery including a spinal arteriovenous malformation (AVM). No case of adverse contrast reaction was recorded.

Discussion

Myelography delineates the spinal cord and nerve roots by the introduction of contrast medium into the subarachnoid space followed by fluoroscopy [4]. The long examination time and maneuvers may cause discomfort to the patient. The introduction of CT in 1972 made it possible to visualize the spinal cord and nerve roots more clearly in the axial plane, with less discomfort to the patient and with shorter examination times [5].

The advent of Helical CT in the 90's made image acquisition faster and with thinner slices providing better resolution. In our experience average image acquisition time of 62secs is a remarkable advancement to what was attainable a few years ago at our institution.

Clinical trials of iopamidol have shown fewer serious side-effects, although the occurrence of headaches and nausea is about equal to that of metrizamide. Metrizamide is an older synthetic, nonionic, water-soluble contrast medium with a low osmolality and neurotoxicity which has been safely used for examination of the entire spinal canal [6,7].

Our use of small volumes of this low osmolar non-ionic contrast medium may have also been responsible for the absence of severe contrast reaction. Myelography is usually indicated when surgery is being contemplated [8], this may have accounted for a higher percentage from surgical specialties.

A GE single-detector helical scanner with a scan rotation of one second was used. We used thin slices with overlapping sections which provide good reformations that help in better appreciation of spinal anatomy and lesion demonstration. Spatial resolution in reformatted images is usually poor, especially in the longitudinal axis, unless thin, overlapping sections are obtained. Some authors [9] report that no further information is made available from reformatted images that were not detected on axial scans, whereas others [10] emphatically disagree. Nevertheless the images we obtained enabled accurate diagnosis of spinal cord lesions such as nerve root compression, multiple level pathology, and mechanical instability, where MR studies would have been the ideal. Our investigative technique involved an initial lateral scout which enabled us to focus on the area of interest thereby limiting patient dose. This was particularly important in younger patients and when the exposure field may include radiosensitive organs such as lung, thyroid, breasts, testes and ovaries as there is no threshold dose.

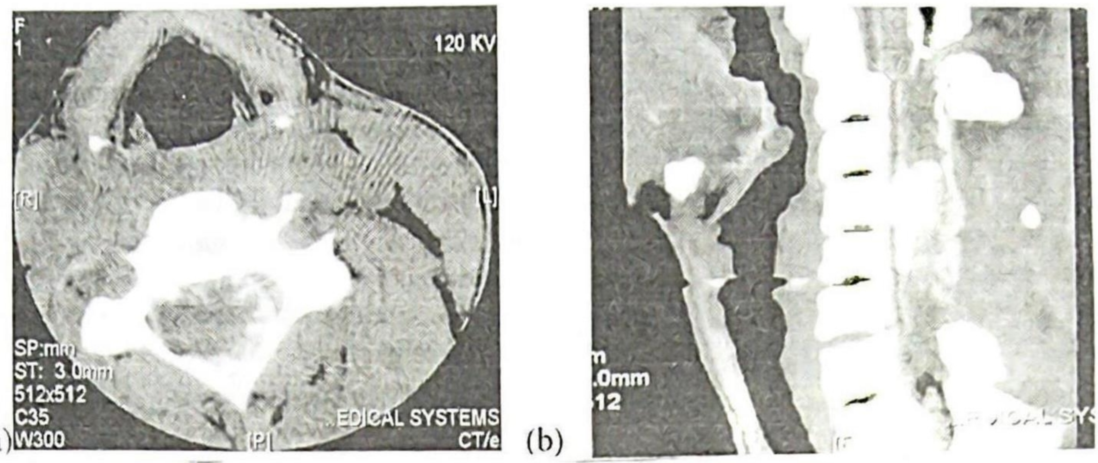
The low frequency (4.7%) of CT myelographic studies over the period of review may have been due to the fact that most requests received were from patients with inconclusive plain myelographic studies or plain spinal x-rays which required further evaluation and pre-surgical cases where precision is important to the surgeon.

The 2:1 male to female ratio appears insignificant, nevertheless the age distribution showed most patients to be between the 3rd and 5th decade and this correlates with the age of increased risk of spinal trauma and other lesions such as neoplasm and disc herniation.

Low back pain and paraplegia were the commonest indication for CT Myelogram in this series accounting for more than 50% of cases. Low back pain is the second most common complaint encountered by primary health care physicians after the common cold [11] and up to 80% of all individuals will experience low back pain at some point in their lives. Unfortunately, a specific diagnosis is not made in 80% of low back pain syndromes [12,13]. Because of these statistics, treating patients with low back pain can be particularly frustrating for clinicians, and imaging is a common diagnostic tool used to gather information and indirect therapy. Post myelographic CT scanning stands out amongst available modalities in our environment for directing therapy. Though non specific back pain is not an indication for imaging unless it has been present for 6-8 weeks at the very least or longer if the pain is subacute [14]. Imaging in low back pain may also be considered when there are symptoms to suggest malignancy, compression fracture or infection. Also age is an important factor as low back pain is uncommon complaint in children and adolescent it therefore prompts early imaging particularly if constitutional symptoms are present [14].

We evaluated three children and four adolescents and found only two adolescents presenting with low back pain. These patients had radiological features of Pott's disease. In this series the thoracic and lumbar spine accounted for more than 50% of the regions requested for evaluation, this correlates well with the indications for requests being mainly low back pain and paraplegia.

We also demonstrated 5 spinal tumours; 2 meningomas (intra and extradural), an intramedullary haemangioblastoma, intradural neurofibroma and a spinal intramedullary Arteriovenous malformation (AVM) (figure 3). An extensive vertebral



a) (b)

Fig. 3a): Axial CTM image showing expansile intramedullary lesion with multiple circumferential theca filling defects in a 26-year-old patient with an intraspinal AVM.
b) CT angiographic maximum intensity projection (MIP) image of same patient demonstrating the lesion.

chondrosarcoma with spinal cord infiltration (Fig. 4) and cord compression from metastatic prostate cancer (Fig. 5) were also confirmed. The case of haemagioblastoma was described in a 27-year-old male. Cord haemangioblastomas are the 3rd most common intramedullary spinal tumour. Most are solitary and occur in patients less than 40years [15].

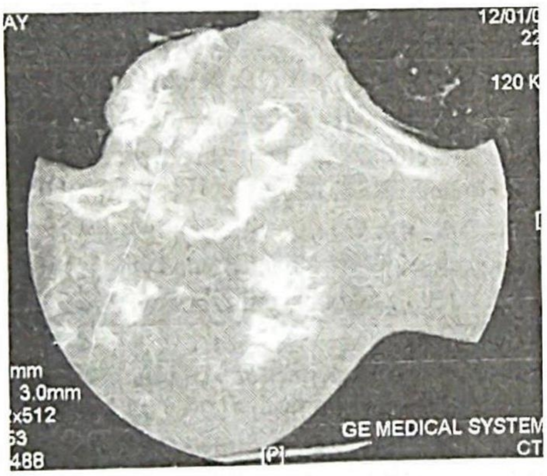


Fig. 4: Axial CTM image showing an extensive expansile lytic destructive vertebral tumour involving the right costo-vertebral joint with cord compression.

Meningiomas are also not rare, Salvati *et al* reported 4 intramedulary meningiomas all occurring in the cervical spinal cord [16]. In this series the extramedullary meningioma occurred in the cervical spine. An intradural meningioma was also demonstrated in the upper thoracic region (Fig. 6).

Although spinal cord ependymoma is the most common intramedullary neoplasm in adults [17] none was found in this study. Spinal AVM are very rare cord lesions [18]. This patient with the suspected spinal AVM was further evaluated with a CT angiography and had successful surgical excision (Figure 3b). The neurofibroma was found in a 23-year-old female which is within the recognized age range for these tumours [19].

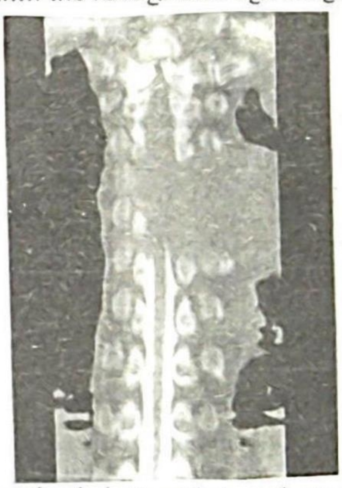


Fig. 5: Metastatic vertebral destruction and cord compression in a 70-year-old man with prostate cancer. Coronal reformatted CTM image showing abrupt termination to flow of contrast medium at the level of T6.

Regarding disc herniation, the spatial resolution of both axial and reformatted maximum intensity projection sagittal images enable clear and uncomplicated diagnosis in suspected individuals (Fig. 7). Haughton *et al* in a previous study showed that CT demonstrates lumbar disc disease as effectively as Myelography [20]. Several authors also believe that myelography combined with CT alleviates the inherent weaknesses of each examination and allows a complete evaluation of the area of interest, indicating that CT scanning with the use of intrathecal contrast medium has increased accuracy when compared with plain CT study of the

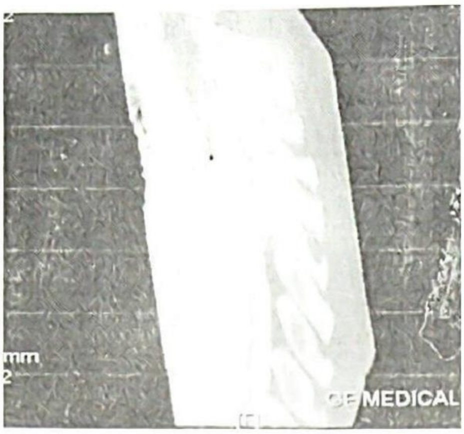


Fig. 6: Intradural meningioma in a 30-year-old female. CTM sagittal reformat shows intradural mass lesion in the upper thoracic region, note the irregular filling defect within theca space posteriorly (arrow)

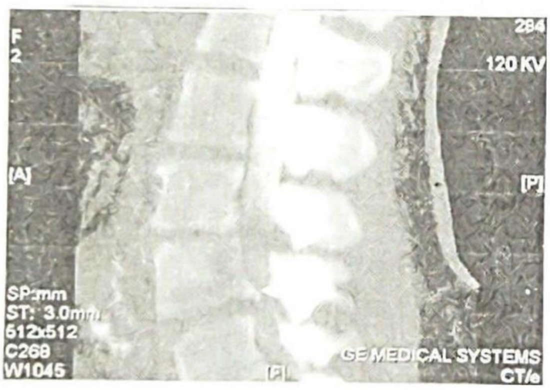


Fig. 7: CTM sagittal reformat shows posterior osteophytes on L3 and L4 extending into the spinal canal and impinging on the nerve roots (arrows) in a 64-year-old female with spondylosis and L3/4 disc prolapse.

spine [21-23]. Shortcomings of the present study include the limited number of cases performed within the period however the conditions described are representative of those encountered in routine clinical practice and the findings support the fact that CTM is a useful investigation for evaluating spinal cord lesions in general especially in the absence of a MR facility which is yet to be universally available in our environment.

References

1. Kaiser JA and Mall JC: Pitfalls in computed tomography of the L-spine. In: Genant HK, Chafetz N. Helms CA (eds): Computed Tomography of the Lumbar Spine. San Francisco, University of California Press, 1982
2. Teplick JG and Haskin ME: CT and lumbar disc herniation. Radiol Clin North Am 1983; 21:259–288.
3. Koeller K K, Rosenblum RS, and Morrison AL. Neoplasms of the Spinal Cord and Filum Terminale: Radiologic-Pathologic Correlation. Radiographics. 2000: 20:1721-1749.
4. Shapiro Robert. Myelography. Year Book Medical publishers, Chicago, third edition, 1975
5. Alfred L Weber. History of Head and Neck Radiology: Past, Present, and Future Radiology. 2001; 218:15-24
6. Fox AJ, Vinuela F and Debrun G. Complete Myelography with metrizamide. AJNR. 1981; 2:79–84.
7. Lamb JT and Holland IM. Myelography with iopamidol. AJNR. 1983: 4:851–853,
8. Lindblom K. Technic and results in Myelography and disk puncture. ACTA Radiology 1950; 34:321
9. Teplick JG and Haskin ME: CT and lumbar disc herniation. Radiol Clin North Am. 1983; 21:259–288.
10. Rothman SL, Dobben GD, Rhodes ML, Glenn WV Jr and Azzawi Y-M: Computed tomography of the spine: Curved coronal reformations from serial images. Radiology 1984; 150:185–190.
11. White AA, 3rd, Gordon SL. Synopsis: workshop on idiopathic low-back pain. Spine 1982; 7:141-149.
12. Reuler JB. Low back pain. West J Med. 1985; 142:259-265.
13. Volinn E. The epidemiology of low back pain in the rest of the world. Spine 1997; 22:1747-1754.
14. Brant-Zawadzki MN, Dennis SC, Gade GF, and Weinstein, MP. Low Back Pain: what the clinician wants to know. Radiology. 2000; 217:321-330.
15. Ferrante L, Mastronardi L, Celli P, Lunardi P, Acqui M and Fortuna A. Intramedullary spinal cord ependymomas: a study of 45 cases with long-term follow-up. Acta Neurochir 1992; 119:74-79.
16. Salvati M, Artico M, Lunardi P and Gagliardi FM. Intramedullary meningioma: case report and review of the literature. Surg Neurol 1992; 37:42-45.
17. Osborn AG. Tumors, cysts, and tumorlike lesions of the spine and spinal cord. In: Osborn A, eds. Diagnostic neuroradiology. St Louis, Mo: MosbyYear Book, 1994; 895-916.

18. Oldfield HE. Spinal vascular malformations; In: Neurosurgery, Wilkins RH, Rengachary SS (eds), 1996; 252:2541-2558.
19. Hamburger C, Buttner A and Weis S. Ganglioglioma of the spinal cord: report of two rare cases and review of the literature. Neurosurgery 1997; 41:1410-1416.
20. Haughton VM, Eldevik OP, Magnaes B and Amundsen P. A prospective comparison of computed tomography and myelography in the diagnosis of herniated lumbar disks. Radiology, 1982; 142: 103-110.
21. Anand A and Lee BCP. Plain and Metrizamide CT of lumbar disc disease: comparison with myelography. AJNR 1982; 3:567-571.
22. Dublin AB, McGahan JP and Reid MH. The value of computed tomographic metrizamide myelography in the neuroradiological evaluation of the spine. Radiology 1983; 146:79-86.
23. Gado M, Hodges F and Patel J. Computed tomography of the spine with metrizamide. In: Post MJ, ed. Computed tomography of the spine. Baltimore, Md.: Williams & Wilkins, 1984; 219-244.

Received 25/07/06
Accepted 19/02/07