

**CORRELATION BETWEEN MRI, CTSCAN AND MYELOGRAPHY IN
DIAGNOSIS OF PROLAPSED LUMBAR DISC AND SURGICAL
RESULTS**

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ABSTRACT

Thirty patients with clinical diagnosis of prolapsed lumbar disc were included in this study. All the patients were exposed to myelography, CT scan and MRI. The results were compared. The surgical results were compared with imaging results. MRI is the first modality in detection of PLD. Combination with myelography and CT scan will improve the accuracy of diagnosis and help to select the type of operation needed.

INTRODUCTION

Disorders of the spine are among the leading causes of the disability affecting the adult working population. Nearly 80% of the adults suffer from back pain during their lifetime (Modic *et al.*, 1991). Prolapsed lumbar disc (PLD) is a major cause of back pain. Clinical and radiological assessment are very important. The common radiological modalities for evaluation of PLD are plain X-ray, myelography, computer tomography (CT scan) and magnetic resonance (MRI) with its own advantages and disadvantages. Myelography is a commonly used

method of identifying a PLD and has a sensitivity ranging from 70% to 96% (Hudgins 1970, Nachemson 1976, Haughton *et al.*, 1982, Bell *et al.*, 1984 and Modic *et al.*, 1986). The advantages of the method are that it gives good over-view, it shows intradural morphology with a very high spatial resolution, further more it has a capability of showing special block and allows provocation, which is of special importance in patients with spinal stenosis (Stig Holtas 1993). Myelography is capable of demonstration tumors of the cauda equina, and the L2L3 level is always

visualized. On the other hand the disadvantages are that it is an invasive procedure that is likely to reveal the presence or absence of nerve root or cauda equina compression. Its sensitivity in detection of lateral herniations or herniation at the L5 S1 level is limited. There are some complications due to the procedure and the contrast material including headache, persistent CSF leak, neurotoxicity (Grainger *et al.*, 1976 and Baker *et al.*, 1978) and that it usually requires admission to the hospital (Szypryt *et al.*, 1988).

Disc material is not directly visualized, but rather, the disc pathology is seen as a defect in the contrast column. CT scan uses an X-ray tube mounted on a rotating gantry to generate a series of cross-section images usually in axial plane. The advantage of CT scan is that it is non-invasive, quick, gives an excellent visualization of the bone in axial projection and it shows the root canal and para-spinal area. It has the ability to visualize disc material directly and its relationship to the adjacent bony structures and thecal sac. It has also the ability to examine both soft tissues and bony contrast

from the same image (Brooks, 1991).

The disadvantages of the CT scan include radiation exposure, the ability to direct scan only on one plane (axial), the effect of the patient's size on the technical quality of the study, a limited number of disc levels are routinely covered, false negative studies may also arise when the area of pathology is not scanned. This may include a conus lesion clinically mimicking a disc herniation or migration of a free fragment distant to the patient disc at level not scanned. Lastly the contents of the dural sac is not visualized unless contrast has been injected into subarachnoid space and therefore an intradural tumor might be missed.

MRI, has started in 1980s, as a new technique, which uses a complex combination of static and alternating magnetic fields to generate images of soft tissues with a high degree of contrast resolution. The advantages include the lack of ionizing radiation exposure, the truly multi-planar capability, that it is non-invasive, it can be done in out-patients clinics, it studies the structures from the conus to the sacrum and provides the best soft tissue contrast allowing

visualization of the disc material, marrow space, the spinal cord and nerves, roots, epidural fat, longitudinal ligaments and the vertebral margins, also soft tissues within spinal canal (Chafetz *et al.*, 1983, Hans *et al.*, 1983, Modic *et al.*, 1986). MRI can also provide not only anatomical details, but also biochemical information regarding changes in the IVD associated with degeneration and herniation. The disadvantages of MRI include its technical complicity, it needs an experienced operator, it is expensive and needs long time for image generation, lastly damage of the metallic foreign bodies (e.g. implants, vascular clamps) by magnetic fields may occur.

MATERIALS AND METHODS

Thirty patients with a clinical diagnosis of PLD were included in this study. The patients had symptoms which had failed to settle after a period of conservative treatment and operation has been considered. All the patients had low back pain (LBP) with or without sciatica, with limitation of straight leg raising and sign of root tension, most of them had neurological deficit. There were

18 males and 12 females, aged from 20 to 60 years (mean 32 years). All the patients were exposed to an MRI scan, CT scan and myelography.

Myelography :

Myelography was performed using 10 ml of an iodinated water soluble contrast agent Iohexal (*Omnipaque*) injected intrathecally. The patients were screened for anteroposterior, lateral and oblique radiograph views. The entire lumbar spines and conus medullaris were examined routinely. We used Skalpe and Amundsen (1975) and Keiffer *et al.* (1987) criteria for diagnosis of PLD. This include angular indentation of the anterior or anterolateral aspect of the thecal sac opposite the disc space, evidence of root sheath amputation and deviation or widening suggestive of nerve root compression.

CT Scan :

CT scan examination was performed with patient in the supine position, A scout view was made for proper alignment of the slices. Three to five mm slices are obtained in a plane as parallel as possible to the vertebral end plate. This can be achieved by tilting the gantry and

minimizing lumbar lordosis by flexing both the knees and hips. A routine CT scan examination of the lumbar spine should contain slices through the vertebral bodies and IVD from the L3 down to S1 level. It is important to visualize the canal at the level of vertebral bodies. This allows the detection of herniated disc fragments that have migrated cranially or caudally from the disc space.

MRI :

The MRI examination was performed with patients in supine position using general electric machine with lumbar surface coils. Multiple slice sagittal studies (7 to 10 mm thick) were performed using T1 weighted spin-echo sequences and T2 weighted spin-echo sequences, which provide good anatomical view. Transverse axial images 7 mm thick were obtained through any suspected level or levels of sagittal images. These were evaluated for disc space height, presence of abnormal nuclear configuration and the absence of epidural fat in the lateral canal. The whole length of the spinal canal was visualized including the conus. The criteria for disc bulging and herniation on MRI are similar to those of CT

scan (Williams *et al.*, 1980 and William's *et al.*, 1982).

The results of each modality were reported independantly without knowledge of the results of other investigations.

The results of surgical exploration findings in the thirty patients were compared with those imaging techniques which had been performed in these cases.

RESULTS

In the 30 patients the L5S1 disc was affected in 10 patients (33.3%). The L4L5 level was affected in 13 patients (34.3%) and L3L4 (3.3%), level was affected in 1 patient 4 patients (9.9%) had double levelwere affection and one patient (3.3%) had 3 level affection. The last one had no PLD herniation and the symptoms were due to the presence of a tumor. The degree of diagnosis certainty for each investigation was recorded.

Mycelography results : there were 22 patients found to have PLD (73%), two patients had doubt findings (6.6%) and 5 patients (16.7%) had negative findings. One patient (3.3%) had medullary tumor. Those seven

patients (two with doubtful findings and five with negative findings) needed further investigations which were necessary to reach the diagnosis. Four out of the seven showed disc affection at lumbosacral level. This was explained by a large epidural space anterior to the thecal sac. One case out of the 22 showed huge disc herniation with complete obliteration of the dye L4L5 (Fig. 1). On the other hand the disc below can not be diagnosed.

In the other three cases, the negative results were explained due to insufficient amount of injected dye.

The CT scan predicted the presence of the disc herniation in 24 (80%) with a reasonable degree of accuracy, one patient (3.3%) had two levels affection. One patient with a sequestered material had been shown in myelography and MRI and could not be detected by CT scan. This was explained by fault in taking a slice at the level of the vertebral body to detect the sequestered material in inter vertebral canal, one miss the diagnosis due to high level of the lesion (L3L4) due to sacralization. 2 patients (6.6%) had negative results. One patient had doubtful result.

The MRI scan predicted the presence of a disc herniation in 26 patients (87%) with a reasonable degree of certainty. There were 3 patients (11.5 %) out of the 26 who had multiple level affection. One patient had degenerative disc disease without herniation. One patient showed negative result for PLD but showed a spinal tumor. Two patients were with doubtful result. The affection of nerve root was confirmed by myelography, one case showed false positive result.

The results of surgical exploration findings in the thirty patients were compared with those obtained by imaging techniques, which had been performed in these cases.

DISCUSSION

Mixter and Barr (1934) were the first authors who described herniation of a lumbar disc as a cause of nerve root compression, which needs surgical decompression.

This needs a safe accurate diagnosis tool to avoid negative exploration. It is agreed generally that the decision to operate should be based on sound clinical and radiological investigations. The

radiological investigation which should confirm the diagnosis still has a percentage of false and doubtful result which leads to unnecessary exploration.

Myelography is an important investigation to exclude nerve root dysfunction (Rothman, 1984), but its accuracy varies (Hudgins, 1970, Nachemson, 1976, Haughton *et al.*, 1982, Bell *et al.*, 1984, Morris *et al.*, 1986) and it has significant morbidity (Grainger *et al.*, 1976). Also there are considerable radiation hazards, it is invasive, painful and needs admission. It directly shows only the subarachnoid space and its contents. On the other hand at the lumbosacral junction because of the varying size of the epidural space, diagnostic accuracy is poor where the thecal sac is narrow and spinal canal is large (Raskin and Keating 1982; Keiffen *et al.* (1982). Also the dura may not extend sufficiently distally and the column of the fluid does not reach the level of the disc affected especially in huge disc. Small disc may fail to indent the dura and may go unrecognized. In cases of huge disc (complete obliteration of the dye) the disc below may be difficult to be identified. (Fig. 1).

CT scan is a non-invasive and excellent for demonstration of the bony condition. But on the other hand it has radiation exposure, giving only one axial cut, also it is difficult to obtain proper cut parallel to the lesion, the size of the patient affect the picture and limited number of level of examination. Also to increase its accuracy it may be combined with injection of the dye. The false negative rate varied from 34% to 57% (Milette *et al.*, 1991). Sequestered material in the canal could not be detected if there is no cut opposite to vertebral bodies.

The MRI has the advantage of being an out-patient procedure which is less unpleasant, non-invasive with no radiation, the whole lumbar spine can be examined in sagittal and coronal planes. On the other hand it is expensive, needs long time of examination and also needs experience. It has affection on metallic foreign bodies. Lastly some patients get afraid from the machine.

The MRI in our study shows its superiority over CT scan and myelography, which is more accurate and precisely confirms the disc bulge and disc disease. It is very accurate to

identify the levels of abnormality, which helps to direct the transverse study by CT scan to the lesion to reduce scanning time.

The affection of multiple disc bulging or herniation leads to confusion, which is the abnormal disc level responsible for the symptoms and needing surgical exposure?. Combined MRI and myelography will show extradural impression on the thecal sac or cut-off, and non filling of the nerve root sleeves will help to localise the needed surgery. Fig (3).

On the other hand implication of multiple disc abnormalities is that failure to respond to treatment could be due to either initial treatment of the wrong level or due to one of the

other abnormal discs becoming symptomatic.

A study that investigated the relationship between the 3 modalities concluded that the MRI is the first investigation to the patient with PLD. This will lead to reducing the number of CT scan and myelography. This study propose a combined approach with myelography, which can be reserved for those patients in whom MRI provided no adequate information about symptoms of compression. Also in cases of equivocal CT scan findings. These sequences lead to very high rate of correct and predict diagnosis of PLD. Also it helps in choice of the type of operation either fenestration, laminotomy or laminectomy.

Table (1) : Showing the surgical procedure done to remove the disc. The uses of the imaging help in selecting the type of operation.

Discectomy through fenestration	15 cases
Discectomy through hemi laminectomy	10 cases
Discectomy through laminectomy	3 cases
Discectomy through multiple laminectomy	2 cases
Laminectomy plus exploration for the tumor (by neurosurgeon)	1 case

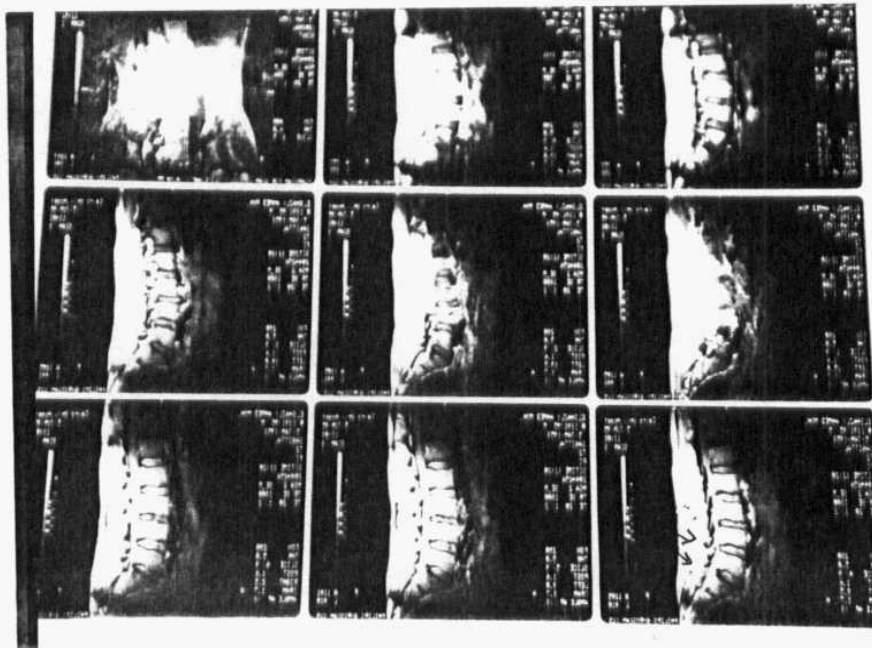
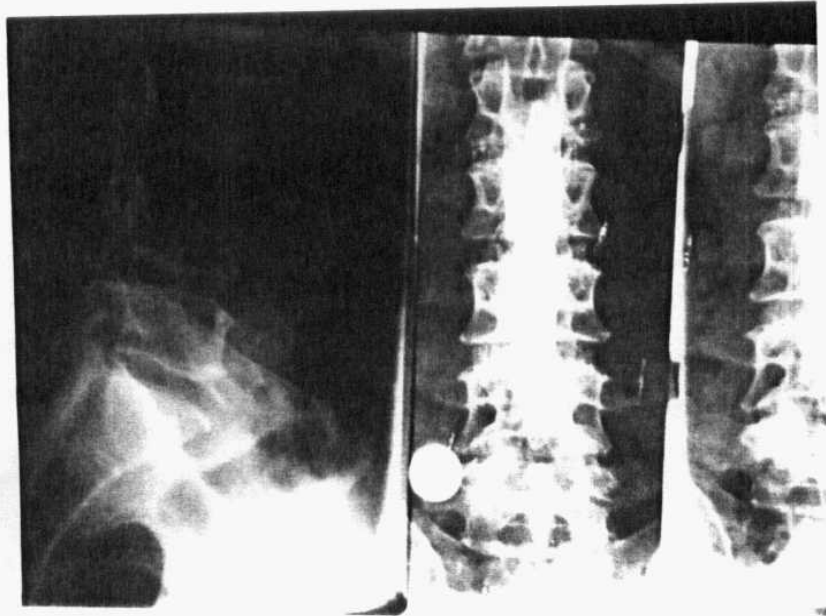


Fig. (1) : Myelography of a man showing complete obliteration of the dye opposite L45. This obliteration gives no idea about the disc condition distal to this obliteration of the dye. By using MRI the presence of another disc at L5S1 detected.

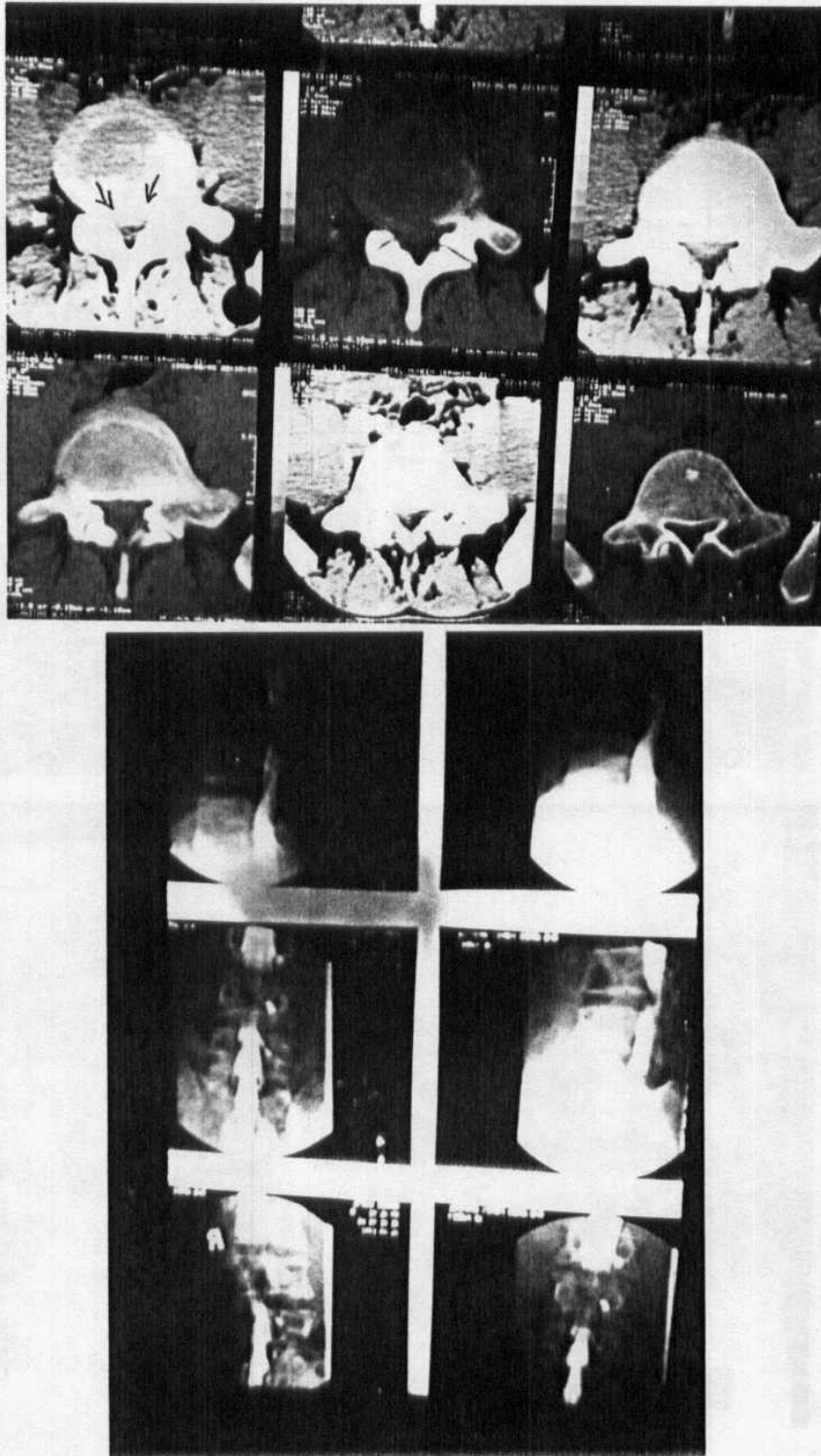


Fig. (2) : CT scan reported a big disc herniation at L45. But in Myelography and MRI the lesion was in L34. This was due to localization of the area examined by the scan, which can not detect the presence of sacralization.

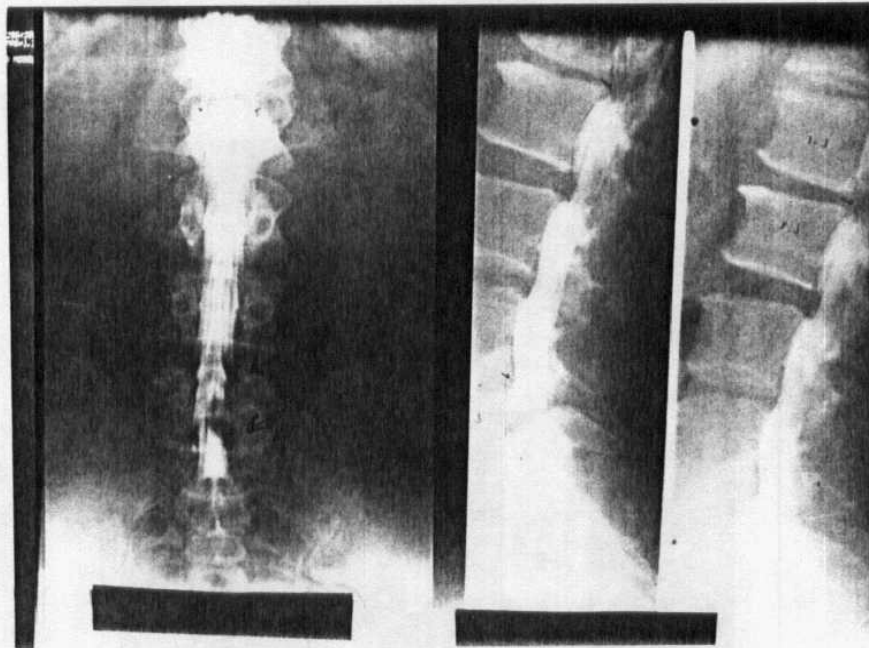
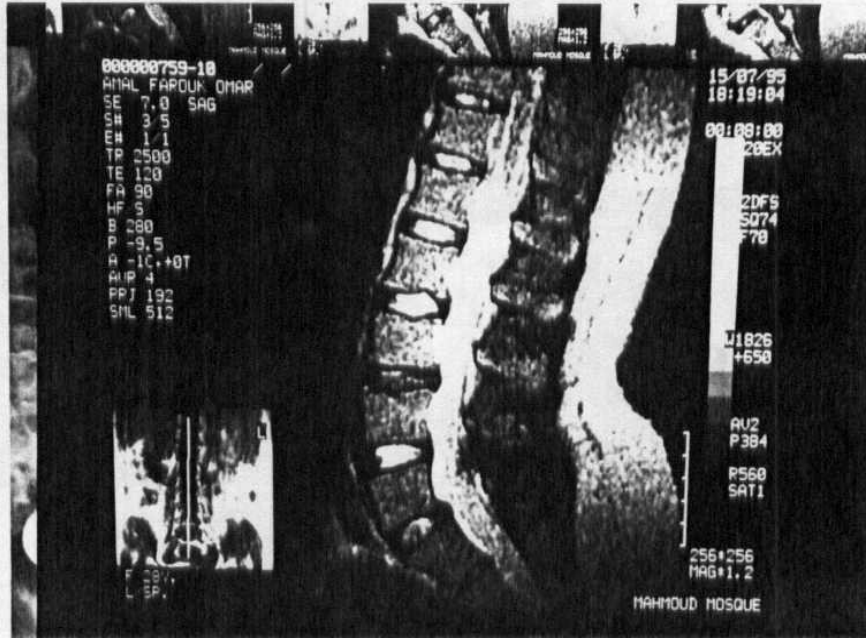


Fig. (3) : MRI showing multiple disc affection. Which disc was causing the symptoms??. The Myelography showed that two roots on one side were affected (L45 and L5S1).

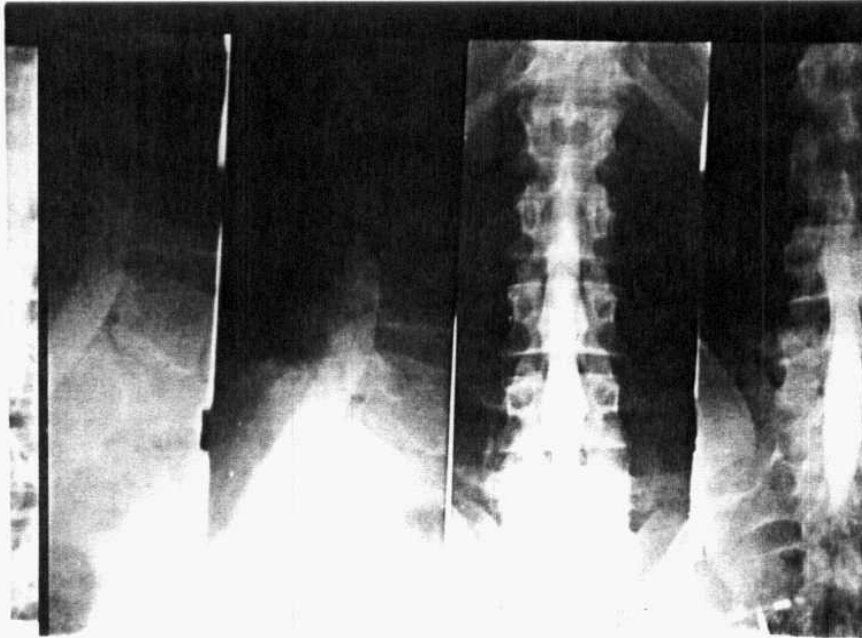


Fig. (4) : Myelography of a man showing negative result. MRI showed degenerative disc at L5S1 which could not be seen by myelography due to wide canal at this level.

CONCLUSION

Combination of MRI and CT with myelography improve the accuracy of diagnosis. It also helps to select the type of operation.

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العلاقة المتبادلة فى استخدام الرنين المغناطيسى والاشعة المقطعية وأشعة الصبغة فى تشخيص الانزلاق الغضروفى والنتائج الجراحية

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المخلص

الطريقة

اشتمل البحث على ثلاثين حالة تعاني من انزلاق غضروفى قطنى . وللتأكد تم إجراء الأشعة بالصبغة والأشعة المقطعية وكذلك الرنين المغناطيسى وتم مقارنة النتائج وربطها بالنتائج الجراحية .

النتيجة

١٠ من المرضى يعانون من انزلاق غضروفى بين الفقرة القطنية ٥ والعجزية الأولى و ١٣ مريض يعانون منه بين الفقرة ٤ و ٥ ومريض واحد بين الفقرة ٣ و ٤ وأربعة من المرضى يعانون من انزلاق غضروفى فى فقرتين ومريض واحد يعاني من انزلاق غضروفى فى ثلاث فقرات . أما المريض الأخير فكان سبب الألم وجود ورم فى النخاع الشوكى .

فى حالة استخدام الصبغة كان هناك ٢٢ حالة بنتائج إيجابية ومريضين بنتيجة غير مؤكدة و ٥ حالات بنتائج سالبة ومريض واحد بورم فى النخاع .

فى حالة استخدام الأشعة المقطعية كان هناك ٢٤ حالة ايجابية ومريض يعاني من انزلاق فقرتين وأربعة مرضى نتائجهم سلبية ومريض واحد بنتيجة غير مؤكدة .

فى حالة استخدام الرنين المغناطيسى كان هناك ٢٦ حالة بنتائج إيجابية وأربعة مرضى نتائجهم سلبية .

الاستنتاج :

إن استخدام الرنين المغناطيسى مع الأشعة المقطعية وأشعة الصبغة فى تشخيص الانزلاق الغضروفى تزيد نسبة التشخيص الإيجابية مما يساعد على اختيار نوع العملية .