Original Research Article

Magnetic Resonance Myelography in Diagnosis of Chronic Low Back pain

Abstract:

Background:MRMyelography(MRM)hasbeenusedasausefuldiagnostictoolthathassome advantagesasbeingnoninvasive,doesnotuseionizingradiationorintrathecalcontrastmaterial, and can be performed easily during routine MR spine imaging. The purpose of our study wasto assess the role of MR Myelography in diagnosis of patients with chronic low backpain.

Result: Outofthestudies30patientswithlowbackpain;10ofthemweremalesand20females with their ages ranged from 20 to 65 years with a mean of 43.4±11.4, and 19 patients were had degenerative disc disease, 7 patients post traumatic, 3 patients spinal canal stenosis and one patient systemic disease, and 14 patients had disc bulge, 15 patients disc protrusion. By MRM, 23 patients had compression on right exit nerve roots and 27 patients on left exit nerve roots, 27 patients had compression on thecal sac. Thecal sac size was mildly stenosed in 18 patients, severely stenosed in 6 patients and wide in onepatient.

Conclusion:MRMisavaluabletoolinassessmentofthechroniclowbackpainwhencompared to conventional MRI as it is the best imaging modality to the thecal sac which show excellent definition of thecal margins, nerve roots and nerve rootsheaths.

Keywords: MR Myelography (MRM), Low Back pain.

Introduction:

Low back pain (LBP) is a common problem affecting at least 80% of all individuals at some point of their lifetime and also the most common cause of disability in individuals with ages between 45-65 years [(1,2)].

Computed Tomography (CT) imaging is nearly as accurate as Magnetic Resonance Imaging (MRI) for detection of serious underlying pathology of LBP, but it is less sensitive in some pathologies e.g., disc herniation, malignancy & infections besides exposing the patient to high ionizing radiation dose. The addition of myelography to CT improves its sensitivity for disc herniation & clinically meaningful lesion but it is invasive technique and requires the use of intrathecal contrast medium which possess the risk of arachnoiditis, infection and hypersensitivity reactions [(3)].

MRI is the diagnostic modality of choice for all potential serious underlying etiology of LBP as it does not expose the patient to ionizing radiation and provides superior contrast resolution for soft tissue visualization, and hence detection of most pathological lesions [(4)].

MRMyelography(MRM)hasbeenusedasausefuldiagnostictoolthathassomeadvantagesas being noninvasive, does not use ionizing radiation or intrathecal contrast material, and can be performed easily during routine MR spine imaging[(5)].

Also, it allows evaluation of nerve root sheath and unlike contrast- enhanced myelography, it is not dependent on spine curvature, gravity effects or the size of thecal sac [(6)].

Patients:

ThestudywasconductedinRadio-diagnosisdepartmentatTantaUniversityHospitalonagroup of30patients(10males&20females),theiragerangedfrom(20-65)yearswithameanageof 43.4 ± 11.422 years. They presented clinically with chronic low back pain and referred over a period of three years from January 2018 to January 2022.

Inclusion criteria:

Patientswithchroniclowbackpainlastingfrom3-6monthswhichwassevereenoughtowarrant surgery,residualsymptomsafterhavingbacksurgery,clinicallysuspectedtohavelumbarspinal canal stenosis and considering an epidural injection to alleviate the pain, associated red-flag factors which indicate serious underlying disorders including: History of malignancy, failure to responsetoinitialtreatment/therapy,prolongedcorticosteroidusesordiagnosisofosteoporosis, history oftrauma.

Exclusion criteria:

Patient who could not have MRI scan including Patients with cardiac pacemaker, non-compatible MRI aneurysm clips, cochlear implants, non-compatible MRI prosthesis, known to have metallic foreign bodies and claustrophobic patients.

Methodology:

All the participants were subjected to the following:

1) **Informed consent:** was obtained from all patients after full explanation of the benefitsand risks. The benefit was to get accurate diagnosis of chronic low back pain, while the risk of this procedure was getting claustrophobic during closedexamination.
2) **Full history taking with stress on** patient personal data (age & sex), Duration of the present complain including history of present condition (onset, course and duration of present complain), previous spinal surgery or trauma or systemicdisease.
3) **Clinical examination**: was performed by neurosurgeon at Neurosurgerydepartment.
4) **Magnetic resonance imaging (lumbosacral spineMRI):**

- The study was performed using 1.5 T MRI signa explorer, GE (General Electric) healthcare machine (closed magnet), imaging was conducted using standard spine coil and in neutral supineposition.
- PreparethepatientbeforeMRIbyMakingsurethatthepatientdoes nothaveanymetal objects like keys.
- **The following MRI pulse sequences were included: -**

  Routine MRIsequences:

  - SagittalT2: TR/TE: 2245/101, FOV: 320×320, 4 mm thickness, NEX: 4 andmatrix: 320* 224.
  - Sagittal T1: TR/TE: 340-560/9-10, FOV: 320×320, 4 mm thickness, NEX: 4 and matrix: 320*224.
  - AxialT1:TR/TE:424-524/3-7,FOV:240×240,4mmthickness,NEX:4andmatrix: 320* 224.
  - Axial T2: TR/TE: 2230/101-150, FOV: 240×240, 4 mm thickness, NEX: 4 and matrix: 320*224.

Magnetic Resonance Myelography (MRM):

The method of MRM is based on suppressing background by using heavily T2 weighted fast spin echo pulse sequences and obliterating fat signal by presaturation.

MR-Myelography was obtained with a segmented multi- shot single slice heavily T2 weighted TSE sequence. A myelographic effect was obtained by adjusting scan parameters to maximize signalfromfreefluidwhileminimizingsignalfromstatictissues.TRof4000ms,TEof250ms, 400 x 512 acquisition matrix, 260 mm FOV & 55 mm slice thickness were used. With these techniques, two different acquisitions were obtained within the same sequence: one coronal planecorrespondingtoanteroposteriormyelographicprojection&onesagittalplaneresembling a lateral myelographic projection. These two images were obtained within a single sequence in a total time of 1:40minutes.

Statistical analysis:

Statistical presentation and analysis of the results was conducted, using the mean, standard deviation, Chi-square by SPSS V20.

Results:

This current prospective study includes 30 patients with low back pain; 10 of them were males (33.33%) and 20 were females (66.66%) with their ages ranged from 20 to 65 years with a mean of 43.4±11.4. demographic data of this study was demonstrated at **Table (1)**.

Table (1): Demographic data of the studied patients.

		N	%
Sex	Male	10	33.33
	Female	20	66.67
Age	Range	20-65	
	Mean ±SD	43.433±11.422	

Theetiologyofchroniclowbackpaininthestudiedpatientsaccordingtoconventional MRIand MRM findings, out of 30 patients, 19 patients were had degenerative disc disease, 7 patients were post traumatic, 3 patients were had spinal canal stenosis secondary to neoplastic cause (lipoma) & 1 patient were had systemic disease (Marfan syndrome that led to Dural ectasia) **Table(2)**.

Table (2): The etiology of chronic low back pain in the studied patients.

Provisional Diagnosis		
	N	%
Degenerative disc diseases	19	63.33
Post traumatic	7	23.33
Neoplastic cause (lipoma)	3	10.00
Systemic disease (Marfan syndrome)	1	3.33
Total	30	100.00

The results of MRI findings of the studied cases. 14 patients were had disc bulge (5 patients at L1-2 to L5-S1, 5 patients at L3-4 and 4 patients at L3-4 & L5-S1), 15 patients were had disc protrusion (7 patients at L3-4 &L4/5, 4 patients at L4-5 and 4 patients at L4-5 & L5-S1). 18 patients were had compression on right exit nerve roots & 24 patients were had on left & 23 patients were had compressions on the thecal sac. Thecal sac size was mildly stenosed at 23 patients, severely stenosed at 6 and wide in 1 case **Table (3)**.

TheresultsofMRmyelographyfindingsthestudiedcases.23patientswerehadcompressionon right nerve roots, 27 patients were had compression on left nerve roots & 27 patients werehad

compression on thecal sac. Thecal sac was mildly stenosed in 18 patients, severely stenosed in 6 patients & wide in 1 patient **Table (3)**.

OncomparisonbetweenthecasesaccordingtothefindingsofMRI&MRM,outof30patients, 23 patients had compression on right exit nerve roots by MRM, while 18 patients by MRI. 27 patientshadcompressiononleftexitnerverootsbyMRM,while24patientsbyMRI.27patients had compression on thecal sac by MRM, while 23 patients by MRI. Thecal sac size was mildly stenosed in 18 patients, severely stenosed in 6 patients & wide in one patient by MRM whileby MRI 23 patients was mildly stenosed, 6 patients was severely stenosed & 1 patient was widely **Table(3)**.

Table (3): comparison between the cases according to the findings of MRI &MRM.

		MRM		Conventional MRI		**Chi-Square**	
		N	%	N	%	X^2	**P-value**
Compression on Rt exit nerve roots	Positive	23	76.67	18	60.00	1.232	0.267
	Negative	7	23.33	12	40.00		
Compression on Lt exit nerve roots	Positive	27	90.00	24	80.00	0.523	0.470
	Negative	3	10.00	6	20.00		
Compression on thecal sac	Positive	27	90.00	23	76.67	1.080	0.299
	Negative	3	10.00	7	23.33		
Thecal sac size	Negative	5	16.67	0	0.00	5.610	0.132
	Mildly stenosed	18	60.00	23	76.67		
	Severely stenosed	6	20.00	6	20.00		
	Wide	1	3.33	1	3.33		

Case 1: 39 years old male patient presented by chronic low back pain radiating to both lower limbs with numbness and tingling (Figure 1).

figure1: Singleslice2DMRMcoronal(a)&sagittal(b)planesshowirregularbandlikefillingdefectwithcomplete C.S.F block opposite level L4-5 (white arrow). There is also amputation of the corresponding nerve root sleeves moreapparentintheleftside.SagittalT2(C)alsoshowsdiscprotrusionatlevelL4-5(bluearrow)andstraightening of normal lumbar curvature. **Diagnosis:** Degenerative discdisease.

Case 2: 42 years old male patient presented by chronic low back pain with bilateral lower limb weakness more at right side gradually progressed over 2 years and urinary disturbances (Figure 2).

Figure (2): Single slice 3D MRM sagittal (a) plane shows a smoothly marinated oval shaped filling defect with minimal internal water content opposite level D12-L1 (red arrow). There is also mild spinal canal stenosis at L4-5 &L5-S1levelthatmayreflectdiscprotrusion.SagittalT1(b)&T2(c)showssofttissuemassatD12-L1levelseen within the intradural space displaying high intensity in T1 &T2 (white arrow) with suppression of its signal at the STAIR (d) (green arrow) & myelography (a), likely lipoma. **Diagnosis:** Intradurallipoma.

Case 3: 56 years old female patient presented by chronic low back pain (Figure 3).

Figure (3): Single slice 2 D MR myelography coronal (a), sagittal (b) with magnified sagittal plane (c) show apparent overlapping of C.S.F column opposite L3-4 level at coronal plane (green arrow) with abnormal stepping C.S.F column at the same level in sagittal planes (white arrow) suggestive abnormal alignment of vertebral bodies. There is also attenuation of root sleeves at the same level (red arrow) with cyst dilatation of sacral dural sac (asterisks). Sagittal T2 (c) show spondylolisthesis at L3-4 (blue arrow) with pseudo disc bulge, sacral dural ectasia (asterisk)withmarkedboneremodelingoftherelevantsacral.**Diagnosis:**Sacralduralectasiawithspondylolisthesis at L3-4.

Discussion:

Lowerbackpain(LBP)isthemostcommonmusculoskeletaldisorder(MSD)affectingtheadult population, with a lifetime prevalence of up to 84%. It was identified as one of the top three occupational health problems to be targeted by the World Health Organization (WHO)[7].

MR myelography is a noninvasivetechnique that can provide anatomic information about the subarachnoid space. Major advantages of MR myelography over conventional radiographic myelography include its lack of ionizing radiation, noninvasivenature and lack of the need for intrathecal contrast material [6].

The method is based on suppressing background signal by using heavily T2 wighted fast spin echo pulse sequences and obliterating fat signal by presaturation. The resulting slices are that projected into a composte image using a standard maximum intensity projection (MIP) algorithm. The technique yields reproducible high-quality images of the thecal sac which show excellent definition of thecal margins, nerve roots and nerve root sheaths [8].

This study aimed at the assessment of the role of MR Myelography in diagnosis of patients with chronic low back pain. It was carried out on 30 patients presenting with chronic low back pain.

Among the 30 studied patients, there were 10 males and 20 females. The mean age of these patientswas43.4±11.4years(range20to65years).Asinthestudyof**JöudA,etal[9]&Goetzel RZ[10]**foundthattheprevalenceratesofLBPinfemaleswerehigherthanmalesatthesameage. On the other side, **Kuijer PPF, et al [11], Beaudet N, et al [12] & Spijker-Huiges A, et al [13]** reported at their study that being male adult was associated with having LBP higher thanfemale adult.

Inourstudy,themostcommoncauseofchroniclowbackpainwasdegenerativediscdiseasesas it was the cause in 19 patients (63.33%). As in the study of **Zhang Y, et al [14]**, stated that degenerativediscdiseaseisthemostcommondiseaseofchronicLBP,accountingfor39%ofits incidence. In the contrast of the study of **Almeida D C, et al [15],** which reported that (65-70 %) of chronic low back pain was due to unknown cause which attributed to muscle tension or ligamentinjury.

In our study, MRI provides detailed information regarding anatomic structure and contributes to differential diagnosis of different cause of CLBP as disc herniation, tumour, fracture, or dural ectasia whereas the cause of an abnormality must be inferred on MRM. MRM has the advantage of demonstrating nerve root compression when multilevel disc herniations are seen on MRI.

MR-myelography has shown nerve roots compression not detected in conventional MR in about (16.67%) of cases on right nerve roots & (10%) of cases on left nerve roots. Also, it has shown compression on thecal sac in (13.33 %) of cases that not detected on conventional MR.

This complementary and relevant information provided by MR-myelography images to the MR spinal examination represents the main reason for their routine use. As reported in **Birchall D, etal[16],**TheadditionofMRMtoconventionalMRimagingwillincreasethenumberoffindings positivelyidentified.

Although in **pui MH, et al [17],** stated that addition of MRM to MR imaging yielded no improvement.

Although MRM gives additional information to conventional MR, misleading results can also occur.MR-myelography,obtainedwith3D-TSET2-weightedimages,isreportedtohavealarge number of false positive and negative results. Lack of CSF surrounding some nerve roots can explain some false positive findings. The visualization of the first portion of the roots would depend on the presence of sufficient fluid.[18]

False negative results are more common. In our study, (16.67%) of the patients had a MR-myelography study that did not show any stenosis in the thecal sac although conventional MR examination was showing mild stenosis. This fact is mainly explained by centrally located protrusionsandsmallherniaswithintheepiduralfatbutnotaffectingthethecalsac.Asthestudy of **Ferrer P, et al [(19)],** 28% of the patients had a MR-myelography study that did not show any abnormality although conventional MR examination was positive. Also, in study of **Thornton M J, et al [(18)],** that told that MRM performed poorly when compared with conventional MR in evaluating the lumbar spine. The disc protrusions found on conventional MR, but not seen on MRM (35 false negatives), is explained by the fact that disc protrusions seen on conventional MR may only displace the epidural fat but not the thecalsac.

We recognized some limitation to this study. We chose to image only in the coronal & sagittal planes. Imaging in both coronal oblique planes would certainly have helped in visualizing the exiting nerve roots more clearly. This was due to the 2D nature of the MRM imaging sequence. Three-dimensionalimagingwouldundoubtedlyhavehelpedtheimagequalityofthereformatted images,butthiswasnotavailabletousasfurtherprolongationofimagingtimewasnotpractical. We did not have surgical or pathological correlation for the abnormalities found in this study, because only a minority of the abnormalities found would have been surgicallytreated.

Conclusion:

ThisstudyrealizedthatMRMisavaluabletoolinassessmentofthechroniclowbackpainwhen compared to conventional MRI as it is the best imaging modality to the thecal sac which show excellent definition of thecal margins, nerve roots and nerve rootsheaths.
WerecommendusingMRMasaroutineinvestigationinlowerspinecomplementarytoMRIfor assessment of the thecal sac and nerveroots.

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Declarations:

Availability of data and materials

The datasets used and analyzed in this study are available from corresponding author upon reasonable request.

Ethics Approval and Consent to participate

This study was approved by the Research Ethics Committee of Faculty of Medicine at Tanta University in Egypt with reference numberof approval: . Allpatients included in this study gave written informed consent to participate in thisresearch.

Consent for publication

Allpatientsincludedinthisresearchgavewritteninformedconsenttopublishthedatacontained within this study. The authors grant the publisher the consent for publication of thiswork.

Abbreviations

MRM: Magnetic Resonance Myelography.

LBP: Low back pain.

CT: Computed Tomography.

MRI: Magnetic Resonance Imaging.

GE: General Electric.

WHO: World Health Organization.